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- Falcon - phishing website detection
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- Lethargy detection and car safety
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Editorial Note

Thomas Edison told "I haven't failed, I have just found 10,000 ways that won't work". Research is a systematic search or investigation of knowledge through scientific methods for formulating hypothesis and making deductions based on data. An open minded good researcher usually adopts a critical way of analysing problems and should possess the skills of perseverance and tenacity. A good research which comprises classification techniques using probabilistic modelling and machine learning can lead to a decision support system which can help solving societal problems.

The objective of Technology and future is to publish up-to-date high quality and original research papers and reviews. As such, the journal aspires to be vibrant, engaging and accessible and at the same time integrating and challenging.

This issue features a series of innovative articles such as An introduction to steam generators of sodium cooled fast reactors, Falcon - phishing website detection, Stress- strain response of glass fiber reinforced soil, Lethargy detection and car safety, Domestic energy monitoring system with power factor correction, IoT based face recognition access control, Experimental study on mycelium bricks and Object identification and recognition for autonomous vehicles.

We would like to take this opportunity to thank all the authors for submitting their papers to Technology and Future journal of Science and Technology and to the esteemed peer reviewers who ensured the articles were of the expected quality.

Editor   Chief Editor

AN INTRODUCTION TO STEAM GENERATORS OF SODIUM COOLED FAST REACTORS

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ABSTRACT

Sodium cooled Fast Reactors (SFRs) can play a major role in achieving energy security of the nation. Sodium heated Steam Generators (SG) which are unique in all respects are used in SFRs to produce high temperature and high pressure super-heated steam. The design and development of SG for the Prototype Fast Breeder Reactor (PFBR) was carried out at Indira Gandhi Centre for Atomic Research, Kalpakkam. Eight SGs of 547 tubes and 155 MW power each were successfully manufactured, inspected and subjected to all quality assurance tests as per the codes. These SGs were installed in position and integrated to the heat transport system of PFBR and is ready for commissioning and operation now. The details of the PFBR SG are covered in this paper. In order to establish the manufacturing feasibility, transportation feasibility, assess heat transfer area margin and to identify the stable operating regime a scale down model of SG with 19 tubes and 5.5 MW thermal power was manufactured and tested. Many other experiments were successfully conducted on the mode SGI and the performance was as expected. The heat transfer margin available was experimentally determined and compared with the value provided in the design. This review article is an exposure to the young researchers in the academic institutions, to inspire them to participate in the research and development in this area and effectively contribute to make nuclear power safe and economic.

I. INTRODUCTION

Nuclear power is an inevitable option for India because of its potential to meet the future energy requirement of the country with minimal carbon dioxide emission. To achieve energy security, the abundant quantity of nuclear fertile material available in-house has to be effectively utilised by breeding it to the nuclear fuel in Fast Breeder Reactors (FBR). The second stage of the three stage Indian nuclear power programme envisages plutonium fuelled and Sodium cooled Fast Reactors (SFRs). Depleted uranium which has more than 99.3 % U 238 isotope is used in the blanket of SFRs. On absorption of neutron, the fertile U 238 isotope at the blanket will be converted to fissile Pu 239 which is the nuclear fuel. The fuel production at the blanket surrounding the core of the SFRs will be higher than the fuel consumption at the core as the ratio is deliberately made more than one. Fast reactors which have high velocity neutron spectrum have the potential to breed fuel. In any thermal or nuclear power plant, in the boiler or steam generator, heat/thermal energy is transferred to demineralised water and produces steam at high pressure and temperature. There are wide variety of steam generators or boilers which are successfully deployed in power stations. In any nuclear reactors the heat produced by fission chain reaction is transferred and transported to Steam

Generator (SG) by means of the coolant circulated through the reactor core. In fast breeder reactors liquid sodium is used as coolant because of its excellent heat transfer properties and favourable nuclear properties. Liquid sodium circulating through the reactor core, which will transfer and transport the heat produced by fission chain reaction is known as primary sodium. The radioactive primary sodium passes through the shell side of the Intermediate Heat Exchanger (IHX) and transfer it to the nonradioactive secondary sodium flowing in tube side in the opposite direction. The hot non-radioactive secondary sodium coming out of the IHX tubes is admitted to the SG shell side. SG is basically a counter current shell and tube heat exchanger. The heat from the non-radioactive sodium is transferred to the high-pressure water flowing in the tube side and super-heated steam at high temperature and high pressure is produced. The most critical component in SFR is the SG because of high operating temperature, high operating pressure and the possibility of sodium water reaction as sodium and water is separated only by a single wall. This article is intended to gives an introduction about the SG of SFRs with special reference to Prototype Fast Breeder Reactor (PFBR) SG to the academic community. The Research and development carried out at Indira Gandhi Centre for Atomic Research (IGCAR) on SFR SG is highlighted in this review article. This exposure will inspire the young researchers in the academic institutions to participate in the research and development in this area and effectively contribute to make the nuclear power safe and economic.

II. HEAT TRANSPORT SYSTEM OF SODIUM COOLED FAST REACTORS

Heat transport system of SFRs consists of primary sodium system secondary sodium system and the conventional steam water system. Two main types of configurations of the heat transport system are generally deployed in SFRs. They are loop type and pool type. In loop type of reactor, the primary heat transport system components such as reactor vessel, IHX and the primary sodium pumps are positioned separately and are interconnected with pipelines. In pool type these components are all positioned inside a sodium pool in a large vessel. In India the Fast Breeder Test Reactor (FBTR) which is operating at IGCAR Kalpakkam for the last 35 years is a loop type of reactor [1]. The PFBR which is in the advanced stage of commissioning at Kalpakkam is a pool type of reactor. Because of enhanced safety consideration, for large power reactors pool type configuration is preferred.
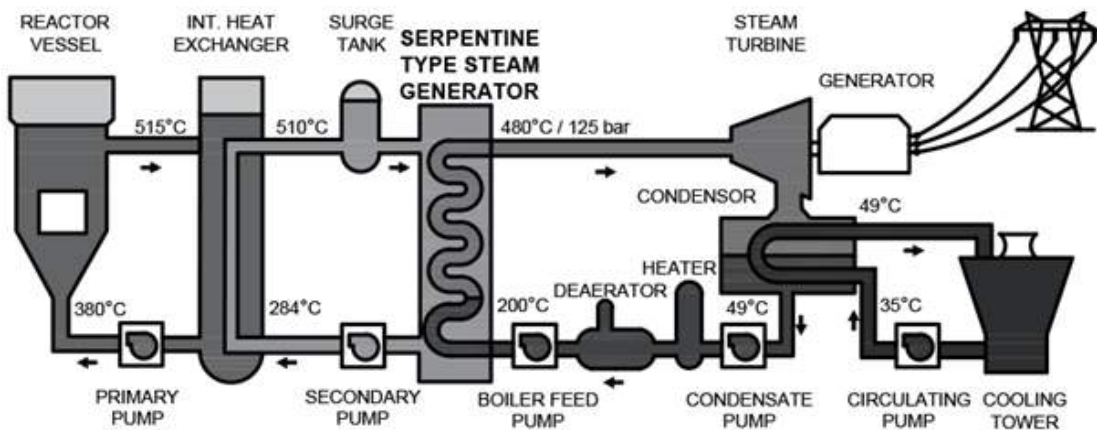
Fig.1: Heat Transport System of FBTR with Serpentine type SG

A. FBTR Heat Transport System

The heat transport system of FBTR is given Fig.1. The SG is a counter flow shell and

tube heat exchanger of serpentine type. In order to increase the tube length and to get adequate heat transfer area 3 "S" joined geometry is used. The selection of this type of design of SG is based on the design adopted by Phénix reactor in France. There are seven tubes inside the shell. The material of construction is 2.25Cr- 1Mo-Nb stabilized ferritic steel. The material selection is based on high temperature properties and corrosion resistance. There are two identical loops in the reactor and only one loop is shown in the figure. In each loop there are two steam generators. Maximum operating temperature at sodium side is 510° C. The maximum operating temperature at steam side is 480°C and the pressure is 125 kg/cm2. The tubes are of size 33.7 mm OD and 4 mm thickness. The SG shell is of 198 mm diameter and of thickness 8 mm. Total heat transfer tube length is 90.4 m. The heat transport capacity of one SG is 12.5 MWth. The excellent operating experience of the SG of FBTR provided adequate data and confidence for the design and development PFBR steam generators.

B.   PFBR Heat Transport System

PFBR is a 500 MWe reactor which is under advanced stage of commissioning at Kalpakkam Tamilnadu [2]. The thermal power of the reactor is 1250 MWth. In order to enhance safety, pool type concept is adopted. Fig.2 shows the heat transport system of PFBR. There are four IHXs in the pool. Two primary sodium pumps in the pool circulate radioactive sodium through the reactor core and shell side of the IHXs. The hot secondary sodium from the tube side of two IHXs were combined at the surge tank, outside the reactor vessel by appropriate piping. Four-steam generators are positioned in one of the secondary sodium loop. Separate outlet pipes form surge tank with isolation valves goes to each of the four steam generators in one loop. There are two heat transport loops and eight steam generators. The outlet sodium from four steam generators with isolation valves leads to the secondary sodium pump. Fig.3 shows the details of secondary sodium system with steam generators in position.
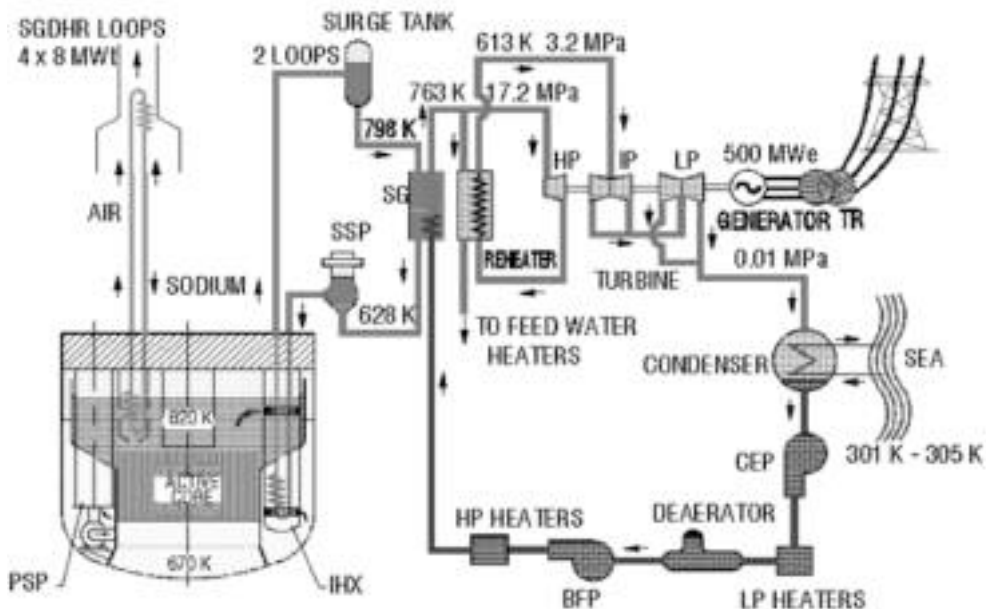
Fig.2: Heat Transport System of PFBR with Vertical SG
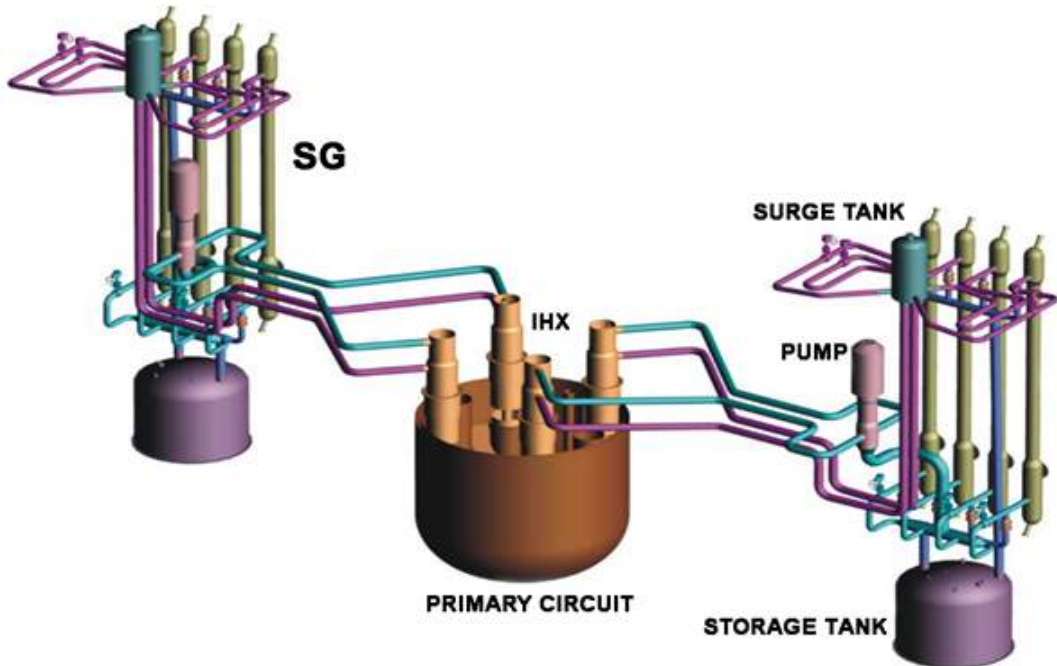
Fig.3: Secondary Sodium System with Steam Generators in Position.

III. DESCRIPTION OF PFBR STEAM GENERATOR

Fig.4 shows the schematic of the SG used in PFBR. In order to ensure Inservice tube inspection vertical tube design is adopted. The heat transfer capacity of one SG is 155 MW. Construction material is selected as modified 9 Cr -1 Mo steel because of its high temperature proprieties and corrosion resistance under sodium hydroxide environment. There are 547 tubes in SG which are arranged in triangular pitch. Size of the tube is 17.2 mm OD and 2.3 mm thickness. Length of the tube is 23 m. Overall height of the SG is 25 m and the overall outer diameter is 1225 mm at top and bottom and 855 mm at the in between portion. An expansion bend is provided for all the tubes in the lower half of SG to accommodate differential thermal expansion between shell and tube. Conical main support is provided at the centre of the SG shell. Tube to tube sheet joints are by butt welding. Bottom and top tube sheets ae machined with projecting spigots. The tubes are butt welded to the spigot to ensure integrity and possibility of radiographic inspection. Tube bundle supports are provided at regular intervals. Thermal shields made of baffles with spacer pins are provided above bottom tube sheet and below the top tube sheet to reduce the magnitude of likely thermal shock; which tube sheets may be subjected to during transient conditions. Manholes are provided at bottom and top on water/ steam side to facilitate tube in-service inspection [3].

Low pressure high temperature sodium from the surge tank at 525 °C (798K) enters the shell side of the SG through top sodium inlet nozzle and flows down and transfer the heat to water/ steam. Low temperature sodium at 355°C (628 K) leaves the SG from the bottom sodium outlet nozzle and leads to secondary sodium pump. High pressure demineralised water enters SG at 235°C (508 K) picks up heat, boils and further heated and become superheated steam.

Super-heated steam at 172 bar and 766 K (493° C) will come out of SG at rated operating conditions. Operating power of SG is varied by varying the sodium flow and water flow and maintaining terminal temperature almost same. The design of this type once through SG is considered for SFRs to limit the total water inventory and the severity of sodium water reaction. The presence of liquid phase, two phase and steam flow in single tube causes hydrodynamic flow instability and flow fluctuations in the steam water circuit. The accurate heat transfer calculations in the two phase region is difficult which made the process design of SG complex.

Development of any crack in the SG tubes and leak of water/ steam into sodium and subsequent sodium water reaction is the major event in sodium heated SG. All the possible measures are taken to avoid leak and bring down the probability to bare minimum. As a second level of defence extensive instrumentation system is provided to detect the leak any at the incipient stage and initiate safety action to reduce the leak and mitigate the effect of leak. Safety devices are incorporated in the sodium system to isolate the leaking SG and to release the pressure and drain the sodium from the system.

IV. RESEARCH AND DEVELOPMENT ON SFR SG

Indira Gandhi Centre for Atomic Research is the second largest unit under Department of Atomic Energy exclusively for the design and development SFR technology. The design and development of PFBR SG and associated system was carried out in IGCAR over years. The manufacturing of SG was carried out by Indian industries.

A. Design of SG

The process design was carried out using various computer codes developed at IGCAR Kalpakkam. These codes are validated with the data generated from FBTR. Mechanical design of SG is carried out as per ASME section VIII div -1. The design life of the SG is 40 years. Selection of the material is carried out after elaborate metallurgical studies. Detailed analysis on sodium water reaction was carried out and leaks are classified based on leak rates.

B. Manufacturing and Quality Control

Manufacturing of PFBR SG was carried out at the plant of M/s Larsen and Tubro at Pawai, Mumbai [4]. The raw materials such as tubes, plates and tube sheet materials are manufactured at M/s Midhani, Hyderabad. The raw materials were subjected stringent quality control tests such as chemical composition, mechanical properties and ultrasonic tests. All fabrication works had carried out in clean room. Stage inspections such as, dimensional checks, LP examination, radiography test, heat treatment etc. were carried out as per relevant codes. The finished component was subjected to pneumatic test, hydraulic test and helium leak test as per codes. The SGs were carefully packed and safely transported to Kalpakkam via. road. SGs were stored with all precautions during construction of the plant and subsequently erected in position and integrated with the heat transport system. SGs are ready for commissioning and operation now.
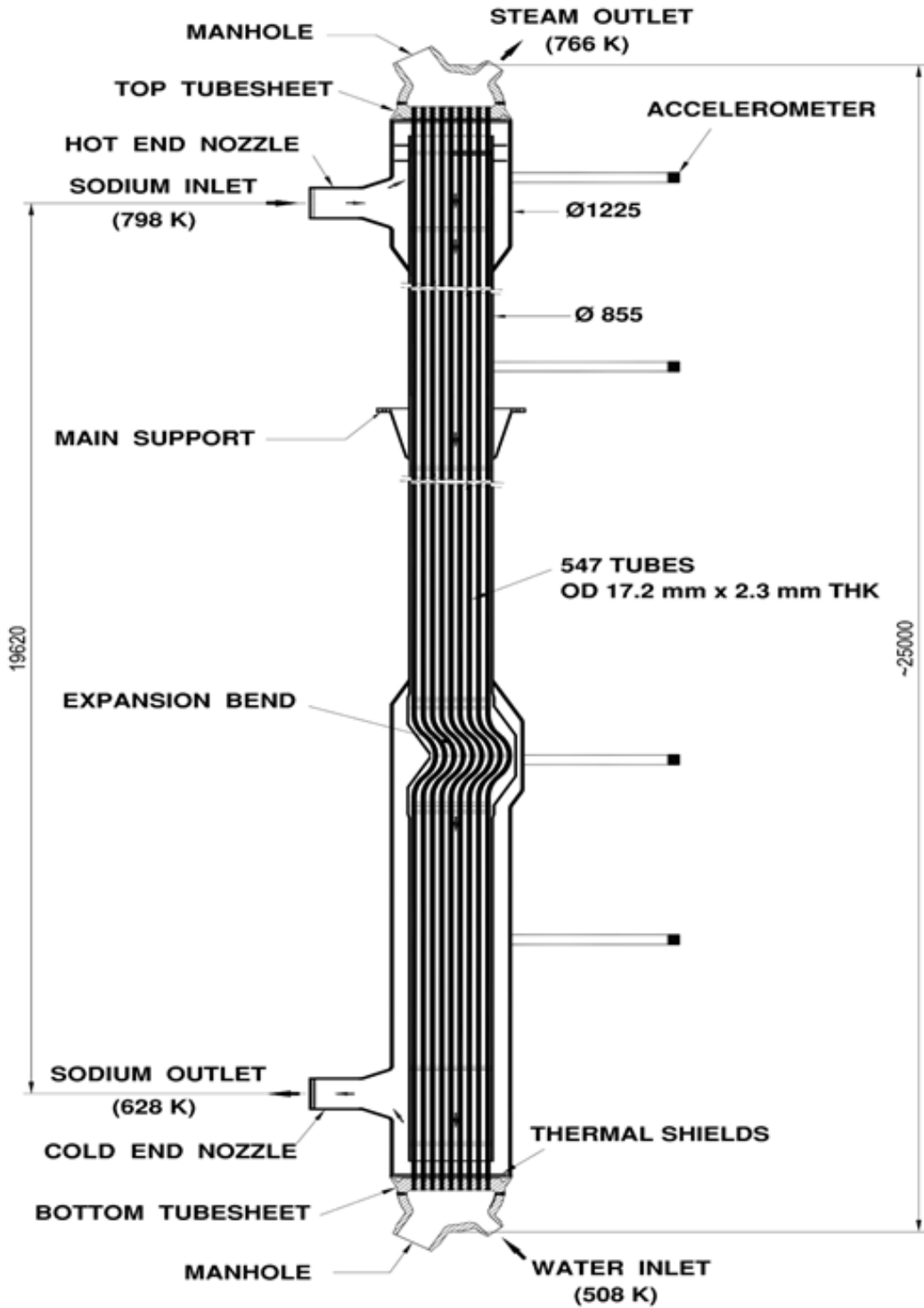
Fig.4 : Schematic of the PFBR Steam Generator

C. Sodium Water Reaction Detection and Special Instrumentation System

Based on the leak rate of steam/water into sodium and the studies carried out by other countries involved in SFR development activities, sodium leaks are classified into three categories. They are micro/minor leak, intermediate leak and major leak. The dynamic behaviour of SG is different for different category of leaks. So detection system and safety action required are also differ under each category of leak incident. For detecting minor leaks the hydrogen content in sodium at ppb level has to be monitored continuously. To monitor hydrogen level, sensitive, accurate, reliable and redundant sensors are developed. Electrochemical type in sodium hydrogen metre and nickel tube based in sodium hydrogen meters are developed and tested in experimental facilities. The performance was as expected and meeting the requirements. Intermediate sodium leaks are promptly detected by cover gas pressure build up in surge tank and is monitored by means redundant pressure switches installed in the cover gas space of surge tank. For large leaks the rupture discs provided in the sodium system will rupture due to sudden pressure build up. The spark plug type sodium leak detectors provided at the outlet of the rupture dicsc discharge line will detect the large leak. During low temperature of sodium at start up condition the reaction of hydrogen with sodium is mild and hydrogen in cover gas has to be monitored using thermal conductivity-based cover gas hydrogen meter. Extensive R & D were carried out towards these instrumentation systems and sensors were designed developed tested and the performance at actual operating conditions and transient conditions during SG operations were confirmed [5].

D. Sodium Water Reaction Studies

Accidental condition of an SG is the occurrence of sodium water reaction. Sodium water reaction which can happen in a SFR SG was simulated in an experimental facility. Sodium water reaction will lead to enormous temperature rise in the reaction zone. The sodium hydroxide in the zone will be highly corrosive. The high temperature and corrosive atmosphere at the leak point and surrounding region will cause high erosion and self-waste of SG tube material and subsequent opening up of the minor crack to a major opening. The leak jet flame formed by the leaking steam into sodium will hit the adjacent tube depends on the leak rate. The local temperature of the adjacent tube will go to very high value and damage the tube due to impingement wastage. This is likely to lead to a major leak due to failure of adjacent tube. Experimental studies have been conducted with SG candidate materials to evaluate the self-wastage and impingement wastage rate of SG tubes under various leak rates and correlations were established.

E. Model SG Manufacturing and Testing

In order to establish manufacturing feasibility, transportation feasibility, asses the heat transfer area margin and to identify the stable operating regime, it has been decided to manufacture a scale down model of SG and experimentally evaluate the performance [6]. A compact scale down model is selected for manufacturing and testing as the cost of full-scale model is very high and thermal power requirement and the consequent energy consumption is huge. Moreover, all the key parameters can be tested effectively in a scientifically selected scale down model. A 19 tube, 5.5 MW, compact model SG is selected for manufacturing and testing. The tube length, tube size, tube thickness tube bend and all the operating parameters are same for the PFBR SG and the model SG. Only difference is the number of tubes were reduced from 547 to 19. A sperate facility by the name Steam Generator Test Facility (SGTF) was built for this purpose. The heat source used for heating sodium was an oil-fired heater. The steam produced in the model

was cooled in stages, condensed and let out to atmosphere through cooling towers. The comparison of various parameters of PFBR SG and SGTF SG are given in Table 1. Fig.5 shows the Flowsheet of SGTF. Fig.6 gives the external view of the SGTF at IGCAR.

Table 1 : Parameters of PFBR SG and SGTF SG

Comparison of PFBR SG and SGTF SG		
Component	PFBR SG	SGTF SG
No. of tubes in SG	547	19
Rated Power	155 MW	5.5 MW
Temperature of steam	493°C	493°C
Pressure of Steam	172 bar	172 bar
Construction Material	Mod 9Cr-1Mo	Mod 9Cr-1Mo
Tube OD	17.2 mm	17.2 mm
Thickness of tube	2.3 mm	2.3 mm
Length of tube	23 m	23 m
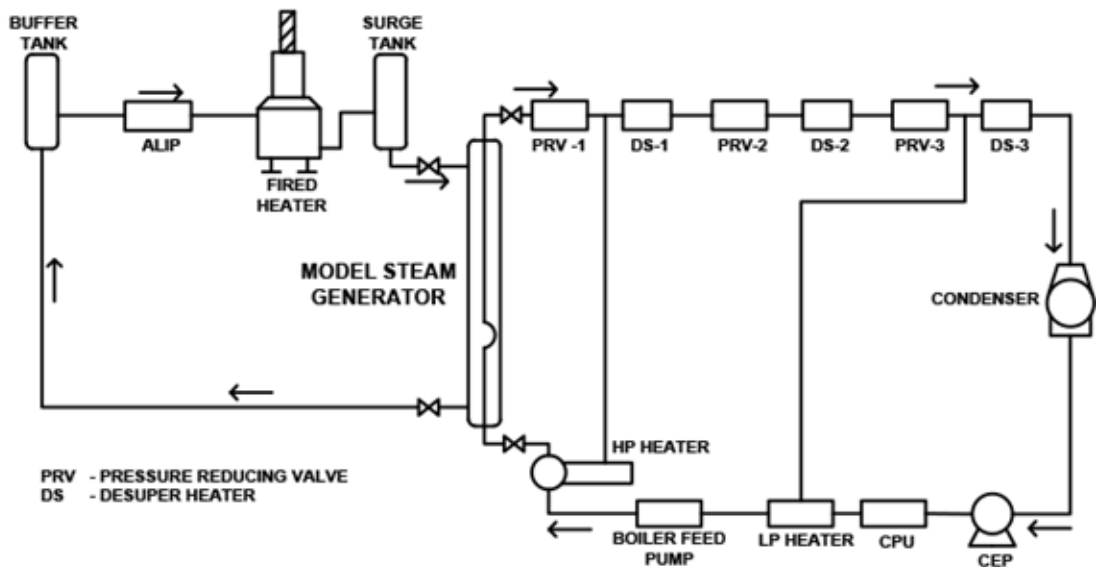
Fig.5: The Flowsheet of SGTF

Fig.6: External View of Steam Generator Test Facility at IGCAR.

The 19 tube scaled down model of SG was tested at actual operating conditions of PFBR. The heat transfer capacity of the model SG was experimentally determined. The margin available for the model SG was assessed based experimental results. The hydraulic stability of the SG under various operating conditions were studied and safe operating regime of SG was identified. The margin of heat transfer area provided to account for the uncertainties in two phase flow heat transfer correlations in the design was 16.5 % whereas the actual margin available was determined as only 12.25 %.

Other additional experiments carried at SGTF are assessment of sodium flow induced vibration of SG tubes, experimental evaluation of hydrogen flux diffusion rate from feed water to sodium in steam generator, studies on SG thermodynamic flow instability due to two phase flow in SG tubes, performance assessment of thermal baffles provided at the tube sheets during transients, demonstrating the operation of SG with a plugged tube, SG endurance test at rated power and feasibility study of using acoustic sensors for SG tube leak detection.

V. FUTURE WORK

The performance of the eight steam generators in PFBR under all operating conditions should be monitored. It is planned to develop 30 m long tube SG for future SFRs [7]. Maximum acceptable tube length is 34m (limited by water mass flux). Present indigenous manufacturing capability of tube is only upto 30m. This design will enhance equipment reliability, make layout compact, improve design life and bring down the cost for fixed plant parameters. Increase in tube length will also reduce number of tubes and tube to tube sheet joints. Table 2 gives the comparison of various parameters of PFBR SG and 30m long future FBR SG. Testing of a 7-tube model of 30 m long SG is proposed in SGTF to demonstrate manufacturability, feasibility of transportation and erection.

Table 2: Comparison of PFBR SG and FBR SG

Plant	PFBR SG	FBR SG
Rated Power (MW)	157	210
Number. of tubes	547	433
Tube OD in mm	17.2	17.4
Thickness of tube in mm	2.3	2.4
Length of tube in m	23	30
Design life	40 yrs	60 yrs
No. of SG/plant	8	6
Material	Mod 9Cr-1Mo	Mod 9Cr-1Mo
No. of tube to tube sheet joints (total)	8752	5196 (~41% reduction)

VI. CONCLUSION

The special type of SGs deployed in SFRs are reviewed and described in detail . The design, manufacturing, operation and testing aspects of this type of SG is covered. Extensive of R & D works carried out at IGCAR

Kalpakkam were highlighted. The article is a review intended to give an exposure to the special type of SGs used in SFRs and to inspire the academic community to take up research in the associated area so that that they can effectively contribute towards making nuclear power safe and economic.

VII. ACKNOWLEDGEMET

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FALCON - PHISHING WEBSITE DETECTION

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ABSTRACT

Phishing is a type of social engineering in which an attacker sends a phoney message to fool a person into giving up personal information or allowing dangerous software, such as ransomware, to be installed on the victim's infrastructure. Due to this action endangering the privacy of numerous people, studies are being conducted to develop detection technologies and improve existing solutions. The detection of phishing is challenging., and many methods, such as a black-list, rule-based, anomaly-based, and so on, have been suggested in the market. Due to its dynamic structure, recent works tend to apply machine learning-based anomaly detection, notably for spotting 'zero-day' attacks, according to the literature. The proposed method assists users in correctly identifying between phishing and authentic websites. By analyzing the website based URL of the web page, we suggested a machine learning-based phishing detection system in this work. The experimental results show that the proposed models operate exceptionally well, with a high success rate.

Keywords—phishing detection, Machine Learning, Artificial Intelligence

I. INTRODUCTION

Cybercriminals, pirates, non-malicious attackers, and hacktivists are all capable of carrying out attacks. The goal is to gain access to the computer or the information it holds, especially to collect personal information in various methods. The most frequent are the Phishing ones and dangerous of these types of attacks. Cybercriminals typically employ email and other communication channels via social networking in this type of assault[4]. Attackers trick consumers into thinking that the message came from a trusted source, such as an e-commerce site, a bank, or something similar. As a result, they attempt to gain access to their personal information. Attackers then use this information to get access to their victims' accounts. It results in both monetary and intangible losses. Attackers like to use a secure communication protocol to communicate with their victims, and by altering it in a manner that is comparable to the original and the genuine URL, is served. At this point, if the victim is aware that the website is phoney, he can protect himself against the attack. For the victim, it is really challenging to notice the assault on his own, because most of these types of messages send out alert messages to users[1], and the goal is to make the user panic in order for him to enter his personal information on the forwarded page. To defend end-users from phishing assaults, various systems for decision support or detection have been created.

These systems employ a variety of methodologies, including 'Blacklists" [3],"Rule-based approaches" [2],"Similarity-based systems", and "Machine Learning-based systems"[6]. The literature was thoroughly reviewed, and the research in this context was thoroughly scrutinized. Machine

learning based systems are currently popular because of its security mechanism against zero-day threats. As a result, the goal of this research is to develop a machine learning algorithm for investigating the target web page's URL address [5] and use this algorithm to detect phishing. The designed method is targeted at detecting phishing assaults without using any third party services in a short length of time or the need to wait for blacklists to be updated, but by using the idea of existing improvable approaches.
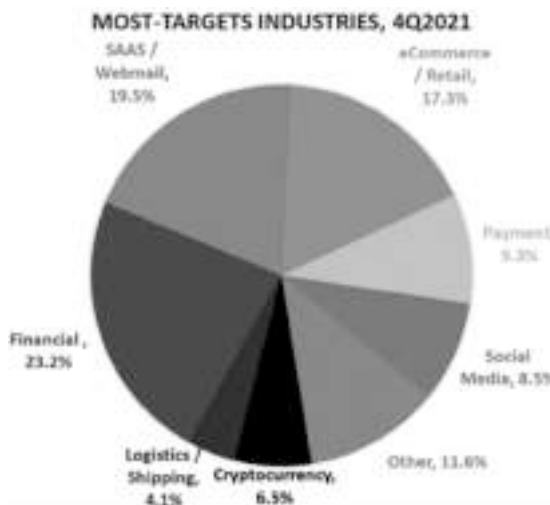
Fig. 1. Sectors susceptible to phishing attacks [1]

Section II of the paper, which offers a thorough discussion of the connected works. The proposed system is explained in Section III. In Section IV, the experimental findings are discussed, and in Section V, the work is wrapped up.

II. RELATED WORKS

A. Using Classifiers and Feature Selection[10]

This study uses a variety of classification algorithms that are based on machine learning , including "Naive Bayes, J48, HNB, and a combination classifier of HNB and J48", using   a set of data that includes "30 properties and 2670 instances of phishing sites". In general, datasets containing an excessive number of attributes

may trick classifiers and hinder them from producing the best outcomes [7]. In order to exclude the lower ranking features, appropriate feature selection techniques are used, which increases the accuracy. Based on the characteristics of each property, all of the attributes are divided into four groups. A classification method is then performed to each group separately, with address bar-based features yielding the best results.

Gathering a phishing website data set from the UC Irvine Machine Learning Repository is the first step. The data collection is then pre-processed such that it is suitable for manual feature selection. Based on the types of attributes in this stage, the complete dataset is divided into four groups. The dataset is then subjected to several classifier applications, with the resulting data being analysed. Then, a ranking system is used to choose features in order to increase the accuracy of detection. To visualise the performance, an ROC curve analysis is used here. With manual feature selection, you examine each type of feature separately and compare them to determine whether any of them are more effective than others at identifying phishing websites. Each tuple in the dataset whose class label is unknown is given a class label through classification. In the second stage, the performance and correctness of the extracted model are evaluated against a predefined test data set. The ROC curve represents the real positive cases percentage that are accurately labeled as well as the real negative cases percentages that are accurately categorized. The true positives to false positives ratio is represented by the ROC curve. The area included in the ROC curve is used to evaluate the ROC graph's accuracy. The combined classifier generated an AUC of 0.99. The feature selection needs to be enhanced to deal with the continual evolution of hackers' new tactics throughout time. The results showed that the group based on address-bar

had the best accuracy in spotting fraudulent websites. After adding a variety of characteristics to the dataset and verifying the combined classifier's performance, the results showed that it had achieved the maximum accuracy rate, which was superior than the outcome computed using all features. Large size datasets and redundancy are the main disadvantages of employing efficient classifiers and feature selection strategies.

B. Using Source Code and SSL Based Features[12]

Hackers adapted an approach of changing IP address of the phishing webpages, so the blacklist based mechanism cannot detect the phishing webpages. Visual similarity methods are useful to detect duplicate copies of legitimate pages [8]. The URL, domain, and webpage source code-based aspects of a Phishing page can be used to identify it. But there are some websites that are hosted by free web hosts, available online where relevant features are not included like the domain's age, page ranking, and SSL certification etc. Black hat SEO techniques help the hacker to advertise his phishing sites and higher indices search result in google. Link spamming boosts phishing page rank also by using a web clicker application, where tons of page views are generated in minutes. By this it is understood that"domain based and URL features" are not helpful for detecting a phishing website. The proposed mechanism uses an algorithm called RIPPER algorithms (Re- peated Incremental Pruning to Produce Error Reduction). This algorithms extracts the SSL based rules and webpage source code from the training dataset. Proposed system is divided into 2 phases: Training and Testing Phase. RIPPER algorithms are used to extract the SSL based features and webpage source code rules in the training phase. In the testing phase, it identifies the phishing webpage by checking the presence of these rules. Proposed system uses RIPPER algorithms, so only 2 features out of 30 are used for detecting the phishing webpage. Also it checks the criteria and neglects the rule if the criterion exceeds the value 0.5. Otherwise rules are stored in the database. (Criterion is the sum of the positive and negative examples divided by the total of the positive and negative examples.). It detects the phishing by following the features. If the SSL certificate authority is unreliable and the certificate's age is less than a year, websites with server side scripts, which sends information to the website owner's mail, using iframe tag, SFH and URL of Anchor, checks whether the form tag in the action field is blank, contains a straightforward file name, or links to a separate website domain. URL request percentage is more than 22 percentages. Other domains link percentage should be greater than 17. The main drawback for this method is that only 2 out of 30 features can be used at a time to detect phishing.

C. Using Web Crawler based Approach[11]

The WC-PAD has 3 phases which includes DNS black- listing, heuristic based techniques and Web spider based procedure. The proposed WC-PAD uses the dataset from real phishing cases. The proposed method has 98.89% accuracy in both zero-day phishing attack and phishing detection.

In the first step, web addresses are extracted and then checked against DNS blacklists. If an IP address matches, an alert is instantly sent; otherwise, the WC-PAD is processed in the second phase. Due to the fact that the attackers do not index every single link on the phished website, the second phase is the Web Crawler, which crawls each web page of a website. It is employed to locate the site indexing error. The WC-PAD notifies the user of an alarm if an incorrect online index is found, or if one of the web pages or links are broken. Heuristic analysis, the third step, contains three characteristics. The web crawler extracts elements such as online traffic, URLs, and content from websites. The WC-PAD is made to extract data from all of the

interconnected URLs in URL analysis. The URL analyzer examines the Levenshtein distance, dots, reports and dictionary words on the discovery of misspelt words. Additionally, it establishes whether the given URL has an IP and checks whether that IP belongs to the domain of the URL. By doing so, you can tell if the website is real or a phishing site.

Web content analysis scrounges through the website's copy- rights and page contents. The analyzer classifies the contents of web pages as legal or illegal based on the crawled pages.   If the contents are illegal, WC-PAD notifies the user via an alert message of the suspect.

Variables including the total number of visits to websites, the page numbers per visit, the average duration of visit, and the bounce rate are considered in web traffic analyzers. The website is categorized as either a zeroth-day phishing website or a conventional website based on these characteristics. In order to determine a website's bounce rate, this analyzer additionally considers Google PageRank and AlexaReputation.

D. Using Parse Tree Validation[13]

This study suggests a method called parse tree approval to determine whether a page is legitimate or fraudulent. By using the Google API to collect all of the hyperlinks on the current page and building a parse tree using the collected hyperlinks. It is a new way to identify phishing websites. Here, the technique has been tried and tested with 1000 legitimate pages as well as 1000 fake sites.

The parse tree approval framework basically consists of three handy areas, like web search engines [10], parse trees phishing page generator, and analyzer.

The point of engagement will receive the Uniform Resource Locator. By using tokenize activity, the domain name will be

recovered from that. The domain name is used to see the phishing site. The first ten levels of the parse tree will be taken into account throughout the tree building process. The domain name that was found will be the root node. As the primary level exits, the top ten recovered connections will take shape. Up to n levels, the same interaction will be repeated.

The Depth-First Search (DFS) calculation is used in the parser step of the tree traversal to determine whether any child nodes have a similar worth to the root node. DFS is a technique for browsing graphs that is similar to preorder crossing in a tree. Each branch's root node serves as the starting point for this calculation, which moves up to the leaf node. The likelihood of the root node occurring for the real site and the phishing site is calculated in light of the root node's redundancy. The possibility of genuineness is high if the root node has been repeated more often than X times. The likelihood of authenticity is medium if the root node repeats itself Y times. The likelihood of phishing is high, and that specific site will be recognized as a phishing one, if the number of repeats of the root node is less than Y times.

In order to deceive the visitors, phishing website pages frequently use wording that is identical to or even similar to that of their target pages. It is a phishing page if the text on a suspicious website page is nearly identical to that on a related significant website page but the area names of the two websites are different.

If the root hub is regularly repeated in the innermost degree of the hyperlinks, the real site will be displayed; otherwise, the site will be regarded as a phishing one. The whitelist's help is related to the phishing targets because of the volume of connections that highlight the same child node. The text matching verified and ensured the phishing's intended goal. In front of the DFS, the tree

crossing is completed. Lexical analysis will eventually be utilized to identify phishing websites.

III. PROPOSED SYSTEM

The proposed system checks the URL, which undergoes pre-processing, where detection of certain features based on feature importance score is carried out. Then testing is performed by extracting the features of the URL. The output of the training dataset is predicted by the output of the ML model, validation set, and the test set. The proposed system's architecture diagram is shown in Fig. 2 below.
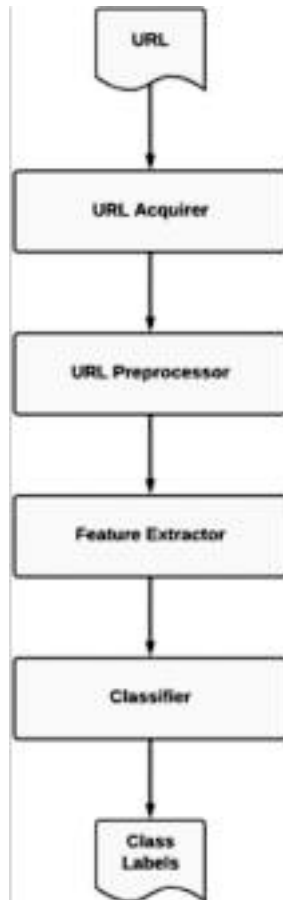
Fig. 2. Architecture diagram of Falcon Phising Detection

A. Dataset

The categorical values of valid, phishing, and questionable websites are included in the dataset used. After that, they were converted into numerical values. Legitimate, dubious, and phishing websites have been substituted by 1, 0, and - 1, respectively. The dataset has 11055 occurrences and 31 attributes, of which 30 are traits that are used to identify phishing websites, and 1 is used to identify targets. The entire dataset is divided into a test and training dataset in order to apply classifiers to it. The split is 80/20, with 80 percent going toward the practice set and 20 percent going toward the test set. Fig 3 displays the distribution of the dataset between phishing and trustworthy websites.
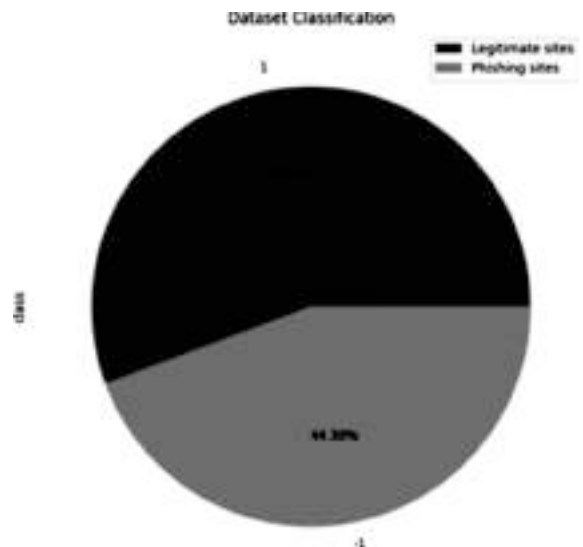
Fig. 3. Distribution of Dataset

B. Feature Extraction

The attributes in the dataset are the features to be extracted from the given URL. Extracting the significant features ensures that the model is trained accurately[14][15]. The hostname, domain, and path sections have each looked at a different aspect of URLs. The features extracted in the proposed

system are listed in TABLE 1.

TABLE I

LIST OF FEATURES

Index	Feature	Index	Feature
1	UsingIP	16	ServerFormHandler
2	LongURL	17	InfoEmail
3	ShortURL	18	AbnormalURL
4	Symbol@	19	WebsiteForwarding
5	Redirecting//	20	StatusBarCust
6	PrefixSuffix-	21	DisableRightClick
7	SubDomains	22	UsingPopupWindow
8	HTTPS	23	IframeRedirection
9	DomainRegLen	24	AgeofDomain
10	AnchorURL	25	DNSRecording
11	Favicon	26	WebsiteTraffic
12	NonStdPort	27	PageRank
13	HTTPSDomainURL	28	GoogleIndex
14	RequestURL	29	LinksPointingToPage
15	LinksInScriptTags	30	StatsReport

To eliminate irrelevant features, feature importance score is calculated on the basis of performing permutation on the full model [16][17].

C. Classification

For classification, 4 different algorithms were considered and experimented and the classifier yielding the best result was used in the proposed system. These 4 classifiers are: "K-Nearest Neighbor (KNN)", "Support Vector Machine (SVM)", "Decision Tree (DT)", and "Gradient Boosting (GB)".

K-Nearest Neighbor classifier is used for classification that generates estimates based on how far k neighbours are apart. However, figuring out this distance with a lot of data requires a lot of memory. The right k value is crucial to the outcome   at the same time.

Support Vector Machine An initial set of training samples from one or the other category is supplied into the SVM algorithm. The algorithm then creates a model and begins categorising fresh data according to one of the categories it has discovered during the training stage. The SVM mechanism aims to find a hyperplane in an N-dimensional space that clearly classifies the points of data. The hyper-plane's features are determined by the number of features. The produced hyperplane acts as a boundary between the categories. A new data point will be categorized into one of the classes when the SVM algorithm processes it, based on which side it arrives   on.

Decision Tree works by segmenting the dataset into smaller parts in order to create the tree. Each node and leaf of the resulting tree are given a feature and a class, respectively. Each internal node in a decision tree represents a check on an attribute, each branch represents a test result, and each leaf node (terminal node) represents a class label. Decision trees are a sort of tree structure that mimics flowcharts.

Gradient Boosting classifiers are a collection of machine learning algorithms that combine a number of ineffective learning models to build a potent predictive model. GB enables the optimization of any differentiable loss function and constructs a forward stage-by-stage additive model. Regression trees are based on the loss function's negative gradient at each stage for n classes. The following are two of the crucial variables that have an impact on the system's accuracy:

learning rate (float, default=0.1): The contribution of each tree is reduced by learning rate. The trade-off between learning rate and number of estimators exists. Values must fall inside this range (0.0, inf).

max depth (int, default=3): The greatest depth of each regression estimator. The maximum depth limits the amount of nodes in the tree. Adjust this parameter for optimum performance; the appropriate setting depends on how the input variables interact. Values must fall inside this range (1, inf).

EXPERIMENTAL RESULT

The legal websites are from Common-Crawl, while the phishing URLs are gathered from the site PhishTank.

The Evaluation measures for performance evaluation are as follows:

Accuracy: The proportion of correctly

anticipated observations to all observations, or accuracy, is the simplest performance metric to comprehend.

Accuracy = $\dfrac{(TN + TP)}{(TP + TN + FP + FN)}$

Precision: In terms of positive observations, the ratio of accurately predicted observations to all predicted positive observations is known as precision. Low false positive rates are associated with high precision.

Precision = $\dfrac{(TP)}{(TP + FP)}$

Recall: The ratio of correctly predicted positive observations to the entire set of actual observations for the class.

Recall = $\dfrac{TP}{(TP + FN)}$

F1 Score: Precision and Recall's weighted average. Therefore, both false positives and false negatives are considered while calculating this score.

F1 Score = $\dfrac{2 * (Recall * Precision)}{(Recall + Precision)}$

where,

True Positive (TP): The number of phishing websites that were correctly identified.

False Positive (FP) websites are those that were flagged as phishing but turned out to be real websites.

False Negative (FN) are the number of websites that were mistaken for reputable ones but were phishing sites.

True Negative (TN): The quantity of accurately categorised trustworthy websites.

The test results of the experimentation using the 4 classify- ing algorithms is given below in Table II.

The classifier that yields better result upon experimentation is the Gradient Boosting classifier with an accuracy of 97.4%.

TABLE II

TEST RESULTS OF CLASSIFIERS

Index	Classifier	Accuracy
1	K-Nearest Neighbors	0.956
2	Support Vector Machine	0.964
3	Decision Tree	0.960
4	Gradient Boosting Classifier	0.974

TABLE III

PERFORMANCE EVALUATION

	Accuracy	Precision	Recall	F1 Score
Training Data	0.989	0.986	0.994	0.990
Test Data	0.974	0.966	0.989	0.977

The performance evaluation of the Gradient Boosting classifier on training and testing is given by Table III.

The training and test accuracy of the system upon variations of the parameters learning rate and max depth of the Gradient Boosting classifier is shown in Fig. 4 and Fig.5
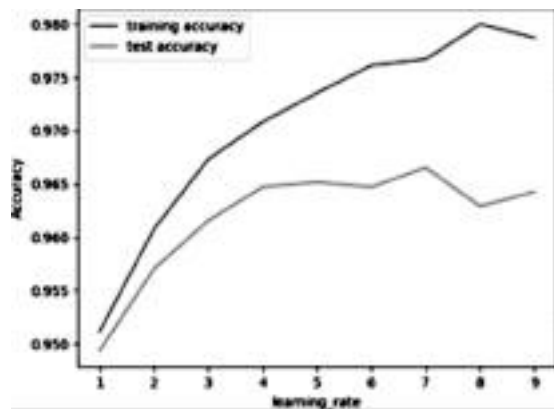

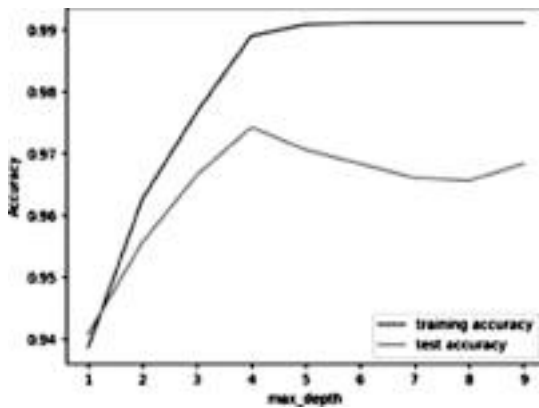Fig. 4. Training and Test Accuracy on varying Learning Rate

Fig. 5. Testing and Training Accuracy on varying Maximum Depth

V. CONCLUSION

Phishing is one of the criminal offenses where the attacker steals the user information like user name, password, sensitive information etc. The attacker uses fake websites to trick someone by appearing as a legitimate website. Phishing detection based on methods such as rule based, anomaly based, visual similarity based, heuristic based etc are really time consuming and inaccurate in some cases. The proposed system uses a standard dataset with over 11000 sites from PhishTank and CommonCrawl which extracts 30 features in order to detect the phishing website. The importance of features is determined by performing permutation of the features. The system uses a machine learning model and an effective classifier, Gradient Boosting classifier, which proved to be the most efficient classifier for the proposed system, chosen after experimenting with a total of 4 different classifiers. The aforementioned system can detect phishing attacks instantly with an accuracy of 97.4%, outperforming prior methods.

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STRESS- STRAIN RESPONSE OF GLASS FIBER REINFORCED SOIL

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ABSTRACT

The present study dealt with the stress-strain responses of a soil sample reinforced with glass fibres. The stress- strain response at reinforced and unreinforced cases is studied by conducting unconfined compressive strength test and unconsolidated undrained triaxial test. The tests were conducted with different lengths and percentages of fibers. The stress-strain response obtained from UCS test shows that fibre reinforcement is effective in increasing the compressive strength of cohesive soil. The failure strain increases with the addition of fibres indicating a transformation in its behaviour from brittle to ductile. The stress-strain response of soil from UU triaxial tests showed an increment in deviator stress at all strain levels indicating shear strength improvement. The tests results show that20mm fibres in the range 0.75% to 1% are most suitable for improving the shear strength of soil.

Keywords—Glass-fiber reinforcement; stress-strain response

I. INTRODUCTION

In most of the situations, we have to construct embankment for road and railway, abutment etc. on bad subsoil. In those situations, we have to either replace those soils with good quality fill materials or we have to stabilize those soils. The first option become difficult now days due to unavailability of suitable fill materials are to be brought from distant places. In those cases, stabilization of top soil by randomly distributed fibre-reinforcement will act as a better solution. A compacted layer of fibre-reinforced soil over weaker soils having low bearing capacity for low budget building projects is a cost-effective method considering the overall cost of the project compared to deep foundations. Like other soil improvement techniques, randomly oriented Fibercon also effectively used for stabilization and improving load carrying capacity. The presence of fibres avoids the formation of the potential failure plane because of the isotropic distribution of strength to the entire soil mass. Fibbers dispersed in the soil mass interlocks the soil particles in a unitary coherent matrix. As fibres are found to be effective in improving bearing capacity and controlling settlement and lateral deformation of soil mass, it can be used in retaining walls and protection of slopes.

II. MATERIALS AND METHODS

A. Residual Soil

The soil sample is collected from Nadukkara, Kerala. The soil sample was grounded properly and made it pass through 4.75 mm sieve to make it free from roots, pebbles, gravel, etc. As per the Unified Soil Classification System (USCS), the soil is classified as medium plastic silt. Liquid limit and plastic limit of the soil were found to be 56.78% and 50% respectively. The soil has a specific gravity of 2.09 and the Optimum Moisture Content and Maximum Dry Density are found to be 34% and 1.31 g/cc respectively.

B. Glass fiber

Glass fibers bought from Ernakulum

are used for the present study. 10mm, 20mm and 30mm diameter fibers of various percentages (0.25%, 0.5%, 0.75%,1% and 1.25%) by dry weight of soil are used.

C. Preparation of sample and test procedure

The index properties of the soil are determined by conducting consistency limit test, sieve analysis, permeability tests as per IS 2720 (Part 5):1985 and specific gravity test as per IS 2720(Part3/Sec 1):1980. Standard proctor test was conducted to find out the Optimum Moisture Content (OMC) and Maximum Dry Density (MDD) of the soil and are found to be 34% and1.31g/cc respectively.

In the initial stage a series of Unconfined Compression Test (UCC) and Unconsolidated Undrained triaxial test had performed. The tests were performed on both unreinforced soil sample and reinforced sample with 10mm, 20mm, and 30mm fibers at 0.25,0.5,0.75,1, and 1.25% by dry weight of soil. Beyond 1.25% tests are not conducted as it is practically difficult to mix at those high ranges. The UCC test was carried out as per IS 2720 (Part 10):1991 and the displacement rate was adopted as 1.2 mm/min. The samples were prepared using 38x76 mm mound at maximum dry density and optimum moisture content. The mixing of fibers with soil was done within 15 minutes after mixing of the soil at OMC, to avoid the variation in moisture condition and density characteristics. The load and deformation readings were recorded at specified intervals and stress versus strain curve was plotted using the readings and the unconfined compressive strength was determined.

Unconsolidated undrained triaxial tests were carried out on soil samples with and without fibre-reinforcement to find out deviator stress at failure. The tests were carried out under confining pressures of 100 kPa, 200 kappa for each sample type. The optimum length and optimum content of fibres to be mixed with soil is determined based up on the

strength improvement achieved.

III. RESULTS AND DISCUSSION

A. Stress versus Strain response

Results obtained from the unconfined compressive strength on both reinforced and unreinforced soil samples shows the effect of fiber-reinforcement on the stress-strain behavior of the soil. Stress-strain response of the unreinforced and reinforced soil samples shows that fiber-reinforcement is effective in increasing the unconfined compressive strength and strain at failure.

A.1 Effect of fibre length

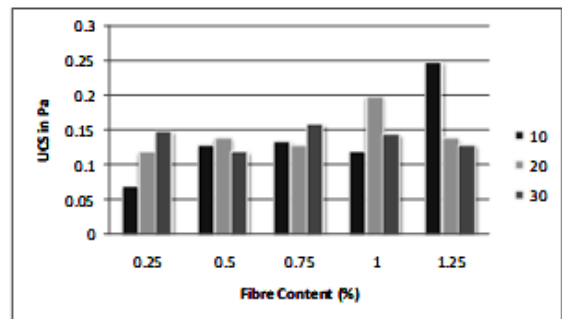Fig. 1.UCS corresponding to constant fiber contents at varying fiber lengths
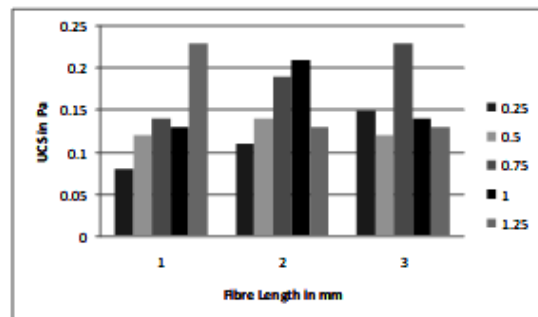

Fig. 2. UCS corresponding to constant fiber lengths at varying fiber contents

The stress-strain relationships obtained from unconfined compression test on soil reinforced with constant fiber content and varying length are shown in Fig.1. They represent the result from sample reinforced with fibers at constant fiber content of 0.25%,

0.5%, 0.75%, 1%&1.25% respectively. For reinforced soil the failure strain found to increase compared to unreinforced soil. The improvement is more predominant for 20mm and 30mm long fiber reinforced soil compared to 10mm long fiber reinforced samples. It implies fibers having length more than 10mm may be benefitted in increasing the failure strain. The increase in fiber length at any particular fiber content in fact reduces the number of discrete fibers in the soil mass. Long fibers due to their higher surface area have more bond strength which allows it to take large strains before failure. More soil-fiber contact enables them to hold in place and eliminating the chances for their slippage.

But in case of shorter fibers, due to lack of sufficient bonding with soil, it may slip before reaching high strain levels. The ductility of the soil specimen increases with increasing fiber content for a particular fiber length, because more fibers are present in the failure region mobilizing more tensile strength.

A.2 Effect of fibre content

The stress strain relationships obtained from unconfined compression test on soil reinforced with fibers of constant length at varying fiber content are presented in Fig. 2. They represent the results from samples reinforced with the fibers of constant lengths 10mm, 20mm and 30mm respectively. The results showed that strain at failure increases with the fiber content for a particular fiber length. Samples prepared at 1.25% fiber by dry weight of soil, being the highest fiber content, depicts maximum improvement in the strain at failure. Further increase in fiber content is practically difficult to mix and the fiber starts to lumps. Formation of lumps reduces the surface contact with soil and creates bonds of weak strength. The increase in fiber content for a particular fiber length brings more fiber participation in tensile strength mobilization near the failure region, lead to enhanced resistance to deformation.

A.3 Variation in peak strength

Peak strength obtained from the compression test is taken as the unconfined compressive strength. From the Fig. 1 and Fig.2, it is clear that peak strength of reinforced soil is more than that of the unreinforced soil. The fibre content added to the soil and the length of the fibres has effect on the degree of strength improvement of the fibre-soil composite. From Fig. 2 it is observed that the UCS of soil reinforced with 20mm and 30mm fibres increases and then decreases. It is also observed that the addition of fibres beyond 1% not have any significant effect when the soil is reinforced with 20mm and 30mm fibres. For comparatively shorter fibres of length 10mm, increase in strength is observed beyond 1% fibre content. When fibres are short, even at high fibre content they can disperse easily into the soil and maintain the isotropy of reinforcement and that contributes to the strength improvement. But in the case of long fibre, it is difficult for them to mix with the soil and contact surfaces between various fibre filaments reduce. At higher fibre contents, for long fibres chances for clogging of filaments and weak band formation inside the composite mass is there.

UCS of fibre-reinforced soil increases with increase in fibre length at fibre contents up to 1% but at 1.25% fibre content UCS decreases with increase in length (Fig.2). It shows that the use of longer fibres is not suitable when the requirement for fibre content is high. Comparing the UCS of fibre-reinforced soil at 0.75% and 1% fibre content for 20mm and 30mm fibres, it is clear that the improvement in strength by using 30mm fibre is very minimal over the use of 20mm fibres. Hence it is proposed that to use 20mm fibres in order to reduce the effort for mixing fibre in the field. Higher fibre contents shall be adopted only if the length of fibres is less and in the present case it is around 10mm.

Small fibres of 10mm length mixed with soil at high fibre content of 1.25% results in a UCS more than that of unreinforced soil. Even though 10mm fibres at high fibre content gives better strength improvement, it lacks in improving the strain at failure compared to longer fibres. Hence it is proposed to choose the combination of fibre length and fibre content as per the requirements in the practical field.

B. Unconsolidated undrained triaxial test

From the study of Unconsolidated undrained triaxial test on on unreinforced soil sample and soil reinforced with 10mm, 20mm and 30 mm fibers at 0.75 % and 1% fiber by dry weight of the soil, under two confining stresses of 100kPa and 200kPa, it was observed that the increase in deviator stress depends on several parameters such as the fiber length, fiber content and confining stress.

B.1Stress versus strain response

The effect of each parameter on the stress-strain response is described with typical plots (Fig 3 and fig 4). The stress-strain response of soil was found to improve with the addition of fibre-reinforcement.

The stress-strain response obtained from unconsolidated undrained triaxial test on soil reinforced with fibres of length 10mm, 20mm and 30mm are compared with that of unreinforced soil in Fig 3 and Fig 5. It was observed that fibre-reinforcement aids in improving the deviator stress of reinforced soil compared to the unreinforced one at a given strain value. It is found that the length of the fibres has an effect on the strength improvement but it is not similar in all combinations of fibre length, content and confining pressures.
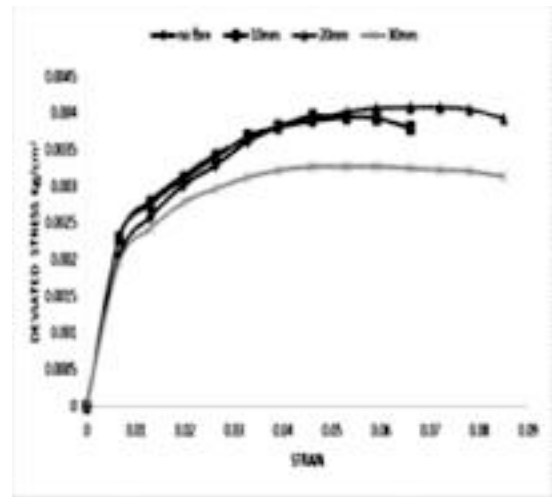
Fig. 4. Effect of fiber length on deviator stress obtained from UU triaxial test (Fiber content=1%; confining pressure=200kPa)
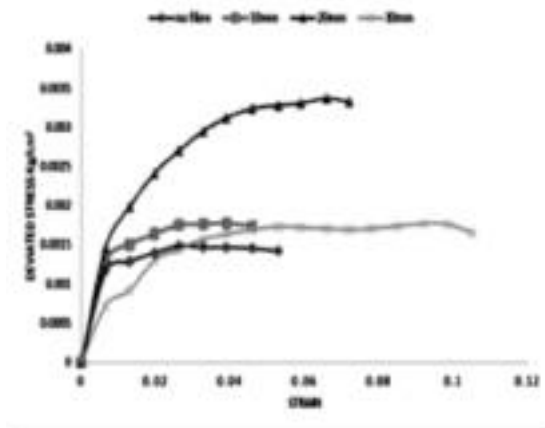
Fig. 5. Effect of fiber length on deviator stress obtained from UU triaxial test (Fiber content=0.75%; confining pressure=100kPa)

But in most cases, samples reinforced with 20mm fibres outperform the 10mm and 30mm fibre-reinforced soil. The less surface bond available between soil grains and fibres in case of short fibres may help to mobilize only less tensile resistance compared to comparatively longer 20mm fibres. Though at any particular fibre content the number of 10mm long fibres in the soil-fibre composite is more than, if the cumulative tensile stress mobilized by all fibres present in

failure region is lesser than strength provided by lesser number of 20mm fibres they can't obviously perform up to the longer fibres. Longer fibres will have more surface bond with soil grains theoretically but when 30mm fibres are mixed with soil it is observed that due to its length and flexibility it bends and makes lumps of fibre mass.

Also, some part of its body comes in contact with itself reducing the surface bond between soil and fibre. The lumps formed by the fibres causes bands of weak strength leading to a strength of composites sometimes even less than that of unreinforced soil. Hence it is proposed not to go for fibres as long as 30mm and stick to a fibre length in the vicinity of 20mm for the soil type under the study.

B.2 Shear strength parameters

Fig.5 shows a plot of modified failure envelope for soil reinforced with 20mm fibres at various fibre contents, in terms of total stress parameters. To obtain the modified failure envelope, p and q are calculated from confining stress and deviator stress at failure as p = (σ1+σ3)/2 and q = (σ1-σ3)/2 or half the deviator stress. It is seen that the failure envelopes of fibre-reinforced soil at various fibre contents lies above that of unreinforced soil indicating an increase in cohesion (c). Table 1 includes the values of cohesion of the plain soil and fibre-reinforced soil at various

combinations officer length and fibre contents.

Fig. 6. Modified failures envelope

corresponding to various fiber contents (Fiber length=20mm)

Sl. No.	Fibre content (%)	Fibre length (mm)	Cohesion, c (kN cm²)
1	0	0	40.3
2	0.75	10	77.4
		20	85
		30	19.42
3	1	10	48.04
		20	99.42
		30	62.42
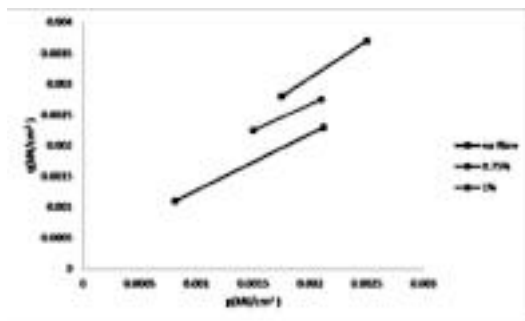
Table.1 Cohesion 'c' at various combinations of fiber length and fiber content

It can be seen from the results that the values of cohesion is highest when the fibre length is 20mm at all fibre contents.2.1 times increase in cohesion is observed at 0.75% fibre content when the soil is reinforced with 20mm fibres and it is 2.5 times increase at 1% fibre content. The value of friction angle, φ for soil at no fibre, 0.75% and 1% for 20mm length of fibres was obtained as 36.73°, 50.19°, 39.81° respectively. Considering all these aspects it is recommended to go for 20mm fibres with fibre content in the range 0.75-1% for the soil type under the current study to achieve maximum improvement in shear strength.

IV. CONCLUSION

A. Conclusion

The stress-strain response obtained from UCS test shows that fibre reinforcement is effective in increasing the compressive strength of cohesive soil. Also, the strain at failure increases with the addition of fibres indicating a transformation in failure mode from brittle to ductile. Both fibre length and fibre content have effect on the increase in strength and ductility. 20mm and 30mm fibres contribute maximum increase in strain at failure. Since the improvement caused by

adding 30mm fibres over the addition of 20mm fibres is minimal, 20mm fibres shall be adopted in field to reduce the effort of mixing. Also, the strain at failure increases with increase in fibre content, providing a maximum increase at fibre content of 1.25%. The UCS of the soil increases by adding 20mm and 30mm fibres at 1 % and 10mm fibres at 1.25% fibre content shows higher result compared to that of 20mm and 30mm fibres. But 10mm fibres are not favourable in increasing the ductility of soil. Hence, for practical purposes it is better to go for 20mm fibres at 1% fibre content considering both compressive strength and ductility improvement. Other combinations of fibre length and fibre content shall also be opted based on suitability for specific requirements.

From the stress-strain response of soil in UU triaxial tests it is clear that fibre reinforcement increases the deviator stress at any strain level indicating shear strength improvement. Soil reinforced with 20mm fibres at fibre content 0.75% and 1% is found to outstand in terms of stress-strain response. Deviator stress at failure of samples reinforced with the combination of fibre length 20mm and fibre content 0.75% is 2.3 times more than that corresponding to unreinforced soil.

Cohesion increases with the addition of fibres. The increase in cohesion is about 2.1 times that of unreinforced soil when reinforced with 20mm fibres at 0.75% fibres, but the variation in the angle of internal friction is not significant. Reinforced soil at fibre content 1% with 20mm fibres also improves cohesion by 2.5 times. Hence the use of 20mm fibres at fibre content in the range 0.75% to 1% is most suitable for improving the shear strength of soil.

B. Future work

The effect of fibre reinforcement may vary with time and drainage; hence it is required to conduct consolidated drained (CD) triaxial test for understanding the long-term effects of fibre reinforcement on the soil under study. Fibre reinforcement technique has wide applications in the field of pavements and embankment construction; hence it is advisable to study the effect of fibre reinforcement on the mechanical strength of soil by conducting CBR test.

To widely adopt this technique widely it has to prove that it is economically feasible. Hence, cost analysis of the method has to be performed based on specific applications.

The results obtained from the triaxial test can be check with the existing mathematical models proposed by researchers. If required modification have to be incorporate or develop a new analytical model which can predict the improvement in soil properties such as shear strength parameters, failure stress, stiffness, energy absorption capacity etc. by the use of fibres as reinforcement.

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LETHARGY DETECTION AND CAR SAFETY

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ABSTRACT

The goal of this project is to develop a means of alerting drivers to lethargic driving behavior. One of the leading causes of road traffic accidents is due to drivers falling asleep. In recent years, we have used a variety of technologies to detect driver drowsiness in the area of crash avoidance systems. This paper propose to develop a coma detection system which is used to accurately monitor state of the driver's eyes in real time.

Keywords- *Lethargy detection, eye aspect ratio, accident detection, ultrasonic sensor, over speed sensor, alcohol detector*

I. INTRODUCTION

A. Overview

Driver drowsiness is a common cause of traffic accidents. In 2016, 7,277,000 road accidents occurred in the United States, killing 37,461 people and injuring 3,144,000, according to a report from the National Road Safety Authority. Fatigue driving was involved in about 20% to 30% of these collisions. According to one study, tired driving is a major cause of traffic accidents. It is important to consider a driver's drowsiness detection strategy to improve traffic safety. To solve this problem, RESE has proposed three different types of fatigue detection methods. Examination of physiological factors, vehicle behaviour, and facial features are the most important factors to consider.

Physiological properties of the driver that measure the driver's physiological parameters using special devices such as electroencephalogram(EEG),electrocardiogr am (EKG), electrocardiogram electro myogram (EOG), electromyogram (EMG). In these methods we analyse changes in the vehicle's characteristic parameters to determine driver fatigue. A vehicle motion-based method that measures vehicle motion such as speed, steering angle, and lane deviation detection and uses this data to estimate driver fatigue. A method based on analysis of driver facial features analyses the driver's face, compares the performance of a tired driver with normal facial expressions, and summarizes some typical fatigue characteristics. In this project, facial feature extraction will be considered and no special equipment is required for the user. The proposed method is much more convenient to implement and easier to use.

B. Problem Statement

Drowsiness and fatigue while driving is a major traffic safety concern, leading to thousands of accidents and deaths each year. In commercial vehicles, the consequences of drowsy driving can be even worse. Drowsiness crashes are often serious, as the driver loses a significant amount of brake response. Reliable safety systems are needed to reduce the severity of these crashes. The most difficult challenge is to detect the driver's physical state in time before starting to sleep, to avoid collisions. To solve this problem, we have to use many different approaches. The first is to effectively recognize faces and extract multiple facial features, and the second is to establish the best conditions to determine if the person is sleepy. A new method to detect drowsy drivers using multiple facial features is proposed. The

effectiveness of the method was evaluated using various performance parameters.

C. Objective

Drowsiness detection in drivers is the principle goal of the assignment. In this contemporary generation in which the variety of street injuries are at the upward thrust with lots of injuries and several fatalities every year, drowsiness and fatigue performs a big position in this. The assignment labored upon right here is to make sure driving force isn't always drowsy and notify if he is. Facial functions consisting of eyes is used for the blinking ratio, eye closure period for sturdy checking of drowsiness. This allows with inside the goal of detection of drowsiness on drivers periodically for a far secure ride. The assignment additionally guarantees that the driving force is cushy without a touch and smooth to put in force techniques for the driver's comfort.

II. DESIGN AND BLOCK DIAGRAM

A. Design

For any engineering product or system, design is the first step in the development process. It is defined as the process of using a variety of methodologies and principles to define a device, process or system in sufficient detail to benefit its physical performance.

A programmer is writing code to solve a problem or automate a process in the early days of software development. Today, systems are so large and complex that teams of architects, analysts, programmers, testers, and users must work together to create millions of lines of custom code. Support our business. There are several steps where the output of one step becomes the input of the next step. 1. Feasibility study and project planning: Create an overview of the project and define the purpose of the project. 2. Analyze the system and define the requirements. Define the functionality and operation of the desired application to improve the goals of your project.3. System Design: Provides a detailed description of expected features such as screen layouts and flowcharts. 4. Execution: The actual code is written. 5 Integration and Testing: Combine all parts in a single test environment. 6. Acceptance, Recruitment, and Deployment: The final stage of initial development when the software goes into production and is used in real business.

Lethargy Detection

(a) Face Detection

The core detection feature performed in the lethargy section is face detection, whether to check if the face is moody. Face recognition is done using Dib. Dib provides two ways to perform face detection. One is the accurate and computationally efficient HOG + linear SVM face detector and the MaxMargin (MMOD) CNN face detector, which is very accurate and very robust in face detection. MMOD face detectors are currently unsuitable for real-time video because they require quite a lot of computing power and are therefore slow to operate. Therefore, we used the HOG + linear SVM face detector for face recognition. The system begins by recognizing faces using a feature descriptor called the Histogram of Oriented Gradients (HOG). HOG is a functional descriptor commonly used for object recognition. This approach detects features based on the intensity gradient or the distribution in the edge direction.

(b) Eye aspect ratio (EAR)

Eye aspect ratio is a measure of how wide your eyes are. When the eyes are open, the ratio of the area of the eyes remain the same, but when the eyes are closed, the ratio quickly goes to zero. Whether the aspect ratio of the eyes drops below a certain level, the software can tell whether a person's eyes are closed. It is calculated using the equation;

$$EAR = \frac{||P2-P6||+||P3-P5||}{2\times||P1-P4||}$$

Where, P1, P2, P6 are 6 eye landmark shown in 68 key points figure. It is calculated by taking the distance between these landmarks as shown.

Open eye will have more EAR

Closed eye will have less EAR

Fig. 1. Eye recognition

(c) Speed Detection

This is a tachometer sensor track coupler module for Arduino. The DO output interface can be directly connected to the IO port of the microcontroller. If there is a sensor that detects a block, such as a motor encoder, speed can be detected. DO module can be connected with relay, limit switch and other functions, it also can be used with active buzzer module, dial alarm.

(d) Distance Measurement

The basic principle of ultrasonic distance measurement is based on ECHO. When the sound wave propagates into the medium, the wave is sent back to the origin as an ECHO after hitting the obstacle. Therefore, we only need to calculate the travel time of the two sounds, i.e. the time to exit and return to the starting point after hitting the obstacle. Since we already know the speed of sound, after some calculations we can calculate the distance.

(e) Accident Detection

The MPU 6050 communicates with processor using I2C protocol. To do this, the pin labelled SDA in the MPU 6050is connected to the analog pin 4 (SDA) of Arudino, and the pin labelled as SCL in the MPU 6050 to analog pin 5 (SCL).

B. Block Diagram
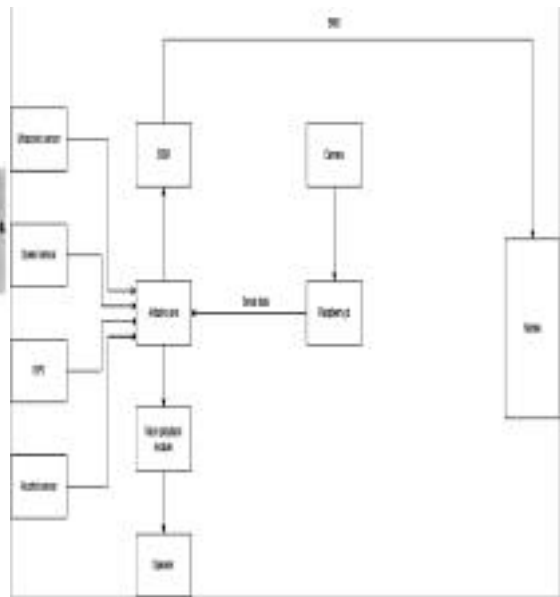
Fig. 2. Accident Detection Model

The parameters determined from the driver image are

• Number of blinks (blinks).

• Average blink time (average blink). The first step in calculating these parameters is to find the driver's face. DLIB's face detector will be used again for this purpose. However, in this case, the landmark detector provided by DLIB is also used. This is its implementation, and the shape predictor utilize of regression trees. DLIB's landmark detectors represent facial features in groups of 68 points, 12 of which represent eyes. This allows you to locate the driver's eyes. To calculate the eye and blink parameters, you first need to calculate how open or closed the driver's eyes are. For this, the proposed technique is to calculate the eye aspect ratio (EAR) by measuring the distance between the upper and lower eyelids and dividing it by the width of the eye, usually the value lies between 0.16 to 0.36. The 0.20 threshold is experimentally determined and the driver is considered to have his eyes closed whenever the measured EAR is less than 0.20.

III. RESULT

The "Lethargy Detection and Car Safety" project has been successfully completed and has gone through its pace. This project was presented to help drivers keep awake while driving to reduce car accidents due to drowsiness. It has the ability to choose whether the driver's eyes are open or closed. A warning sign, i.e. H, when the eyes are closed for a very long time. The buzzer sounds to the driver, and if the driver does not respond to the buzzer, the vehicle will also stop. The proposed system can be used for driver`s safety and its consequences.

Fig. 3. LCD Screen

IV. ADVANTAGES AND SOCIAL RELEVANCE

A. Advantages

☐ Reduction in road accidents: Considering safety as the main objective, various transducers and other methods have been incorporated in the system to detect and warn accidents.

☐ Detection of drowsiness: Detection of drowsiness while driving is a leading objective in advanced driver assistance systems. The alertness state of driver is assessed successfully here by using eye aspect ratio and the driver is alerted by a buzzer sound as well as warning is displayed on the LCD screen.

☐ Accident detection: If an accident occurs, the owner of the vehicle will be informed about this along with the location via an SMS. Thus, even if accident occurs is remote areas, quick medical help could be provided.

☐ Speed detection: Over speed is a major contributor to road accidents. The speed is being sensed continuously and when it increases above a certain limit, a warning is displayed on the LCD screen.

☐ Obstacle detection: Any obstacle is detected by the ultrasonic sensor in the system and warning is displayed on the LCD screen.

☐ Alcohol detection: Drinking and driving causes a major threat to life. Alcohol sensor is employed in the system.

☐ The components and the system establish interface with any driver very easily. So, this allows any person to drive the car and the system will perform normally as expected.

☐ All warnings are provided in real time and without much lag therefor it helps prevent accidents.

☐ Easy traffic management is possible when cars use this system and better road safety is assured.

☐ This system is practically applicable and is very useful.

B. Social Relevance

Safety while travelling on road is a major concern nowadays. There are many reasons for the road accidents and it is really very important that safety, especially in cars be taken care of. Drowsy driving is a significant issue while driving. The danger, risk and sometimes catastrophic consequences of sleepy driving are disturbing. Drowsy driving

is the perilous mix of driving and being sleepy or fatigued. This usually happens when the driver doesn't get enough sleep, but it can also happen due to untreated sleep problems, drugs, alcohol use, or shift work. According to traffic accident data in Korea over the past five years, drowsy driving is one of the leading causes of traffic accidents, with the fatality rate more than double that of other drivers. Causes of traffic accidents. Almost 2.030% of all accidents are caused by fatigue. Some facts and figures indicate that one in 25 adult drivers (age 18 and older) have reported falling asleep at the wheel in the previous 30 days, while the National Highway Traffic Safety Administration National Highway Traffic estimated that drowsy driving caused 72,000 crashes, 44,000 injuries, 800 deaths in 2013. It is possible to minimize the fatality rate associated with all these types of traffic accidents by identifying and alerting drivers from driving when drowsy.

Therefore, we designed a robust drowsiness alerting system with noncontact multiple facial feature extraction using camera by extracting the region of interest making it reliable without hindering driving. This in turn can reduce road accidents to a very large extent making road travels less hazardous and safe reducing road accidents to more than 30 percent. In addition to that, there is a speed sensing module for sensing the speed and it is displayed on the LCD display in case of an over speed. This is an important part of car safety since over speed is also one of the major reasons for road accidents. The ultrasonic sensor used will detect obstacles and display them. There is also a built-in alcohol sensor that will detect if the driver has been drinking and this helps to avoid accidents due to this. There is an accident detection system in this project. In the event of an accident, the vehicle owner will be notified of the location as well as the location by SMS.

V. CONCLUSION

Driver fatigue has repeatedly been identified as a contributing cause of road crashes. Therefore, this project proposes a system to assess driver fatigue or drowsiness while driving. The algorithm used in the project determines whether the eyes are closed or not.. The proposed system could be used to ensure driver safety and its consequences.

The project also looked at other areas of automotive safety such as the speeding of the speed sensors used in the system. There is a speed detection module to detect the speed and it is displayed on the LCD screen when over speeding. This is an important part of car safety since over speed is also one of the major reasons for road accidents. The ultrasonic senor employed will sense the obstacles and display. Also, there is an alcohol sensor incorporated which will sense if the driver is has consumed alcohol and this helps to avoid accidents due to this. There is an accident detection system in this project. If an accident occurs, the owner of the vehicle will be informed about this along with the location via an SMS. The project aims at reducing the road accidents, considering the safety to the driver as well as the passengers. This method`s performance is tested in this research and the experimental findings indicate that this approach is easy to construct and has good detection accuracy.

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DOMESTIC ENERGY MONITORING SYSTEM WITH POWER FACTOR CORRECTION

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ABSTRACT

Energy monitoring gives crucial information that can aid in future energy control and conservation. The smart energy monitoring system technology keeps track of how much energy is used. Globally, energy resource management is a big concern. Energy management actions help to reduce the negative effects of energy generation on the environment. Reduced power system losses, increased load carrying capabilities, and reduced power system losses are all advantages of power factor correction. New design of a smart energy meter linked with a monitoring and control system to monitor the quality of electrical power delivered to customers and to safeguard them in the case of a power outage, with the capacity to save all events in real time as a history.

Keywords—*Energy Monitoring, APFC-Automatic Power factor correction*

I. INTRODUCTION

Power generation efficiency is critical right now, as power waste is a global issue. Energy monitoring gives crucial information that can aid in future energy control and conservation. Without energy monitoring, you won't be able to tell where inefficiencies exist in your company and how to fix them effectively. The most important needs for businesses to reduce their energy spend are energy monitoring systems. The smart energy monitoring system technology keeps track of how much energy is used. Globally, energy resource management is a big concern. Energy management actions reduce the negative effects of energy generation on the environment. Advances in electronics have made it possible to apply a variety of technical solutions that could help reduce energy usage in recent years. The power factor of a system assesses its power efficiency and is a significant factor in increasing supply quality. A weak power factor caused by the increased use of inductive loads is frequently disregarded in most power systems.. Capacitor banks are the most widely utilised device, and they are manually turned on and off as needed. If the correcting devices can be switched on automatically, it will not only enhance response time but also eliminate any room for error. The use of shunt capacitor banks for Power Factor Correction (PFC) is a well-proven technique. The most current tendency is to automate the capacitor switching method in order to gain the best advantage in real time. Energy monitors can remind you to make changes that save energy. New design of a smart energy metre linked with a monitoring and control system to monitor the quality of electrical power delivered to customers and to safeguard them in the case of a power outage, with the capacity to save all events in real time as a history.

II. DESIGN

The software EasyEDA is used to design the PCB for the proposed system. It's a simpler and more powerful online PCB design tool for electronics experts, educators, students, makers, and enthusiasts to create and share products. This is a design tool that combines the LCSC component catalogue with the JLCPCB PCB

service to assist users turn their ideas into reality. The proposed system's PCB design includes a transformer with a 12V AC output that must be converted to 5V DC. A full bridge rectifier is used to convert this 12v AC signal to 5v DC, after which it is sent through a filter capacitor and finally an LDO and thus an output of 5V DC is obtained. The PCB layout is shown in Fig.1
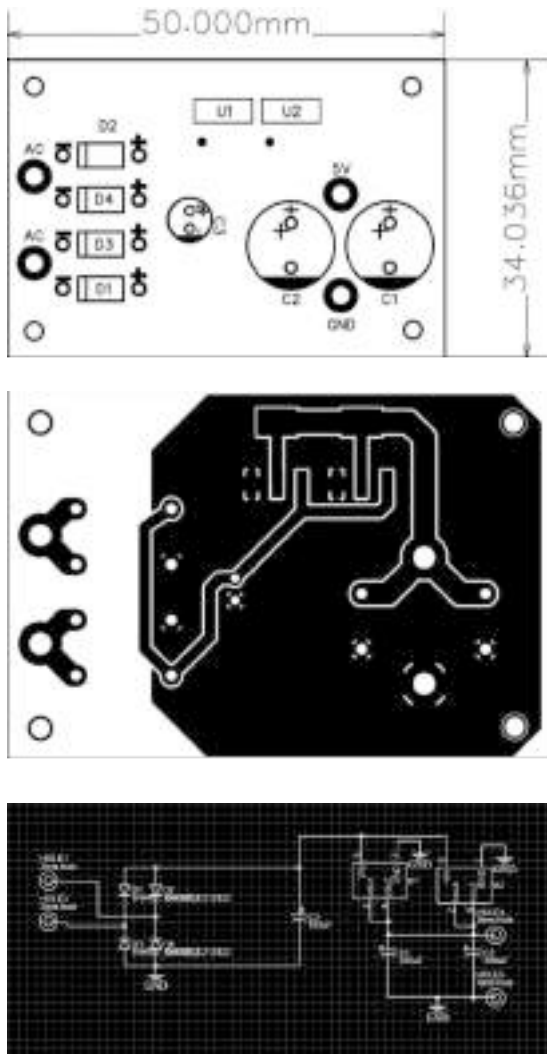

Fig. 1. PCB design

Project cases not only protect the internals from getting damaged , but they also make custom-built devices easier to handle and use in everyday life. Off-the-shelf project boxes are perfect for when there is not a lot of

time and require a quick solution. The case for the energy monitoring system with power factor correction is as shown in the figure 1. Fusion360 is a professional-grade accurate CAD tool for designing components for various applications. The box is designed using the application fusion 360 with dimensions 15cm*10cm*3cm. Four holes are provided for the four LEDs which do the functions as one for wifi another for power factor correction and next one for on and off the circuit one of the led will be kept on if any error occurs. A cut out is given for the LCD display as per the measurements as shown in Fig. 2.
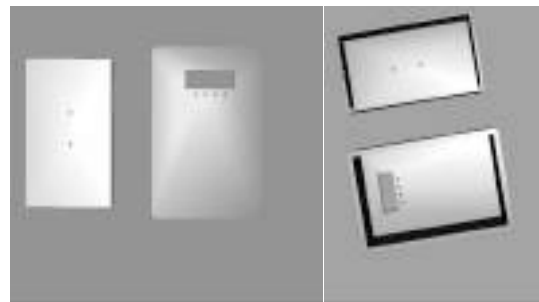
Fig. 2. Design of electric box

III. WORKING

ESP32 is the main board and this provides Wi-Fi (and in some models) dual-mode Bluetooth connectivity to embedded devices. This is shown in Fig. 3.

It is mainly used for the switching of capacitors in the system it is more convenient than normal electro mechanical relays as the time consumption is comparatively less and there are no moving parts the switching of the capacitors can be done in fast manner and thereby the power factor can be improved. The SD card module use in this The SD Card Module is to store the status and measurement data of the electric home appliances. The system also consists of four LEDs One is used for the connection of Wifi One is used for power factor correction another led is used for on or off the circuit.

One of the led will be on all the time if any of the error occur. All the readings are uploaded to the mobile app, details shown in Fig. 4.
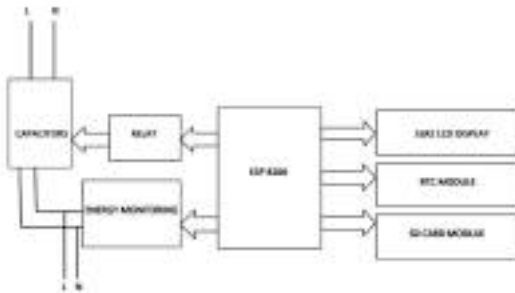
Fig. 3. Block diagram

IV. RESULTS AND DISCUSSION

The Thing Speak IoT platform is used in such a way that it provides applications to analyze and visualize the data in MATLAB. Following are the readings that obtained from things speak.
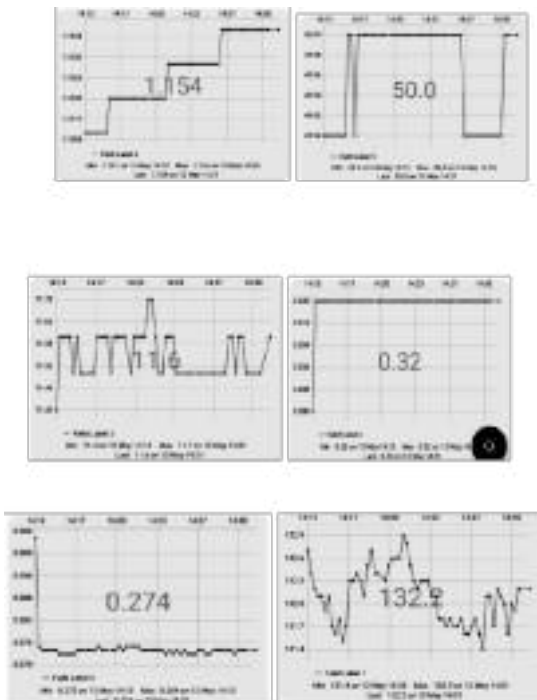
Fig. 4. Readings from thingspeak

V. HARDWARE IMPLEMENTATION

The designed PCB as per above measurements and standards and the proposed system is given below, Fig. 5:
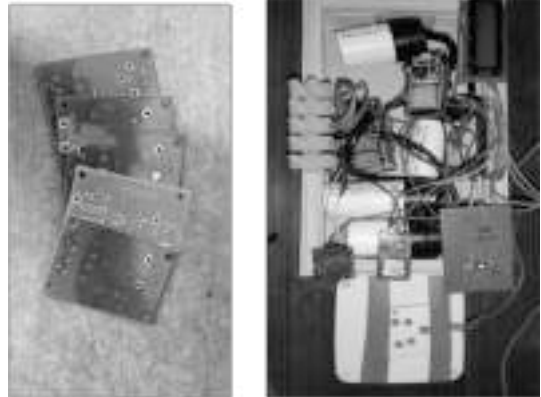
VI. ADVANTAGES AND APPLICATIONS

1.   Provides rating tracking based on time of use

2.   Reduction of energy costs and/or energy bills

3.   Reduction of energy consumption & CO_2, which has a positive effect on global warming

A. FUTURE SCOPE

The designed equipment was only investigated for residential uses, and it can be used for domestic reasons with the possibility of subsequent growth. As a result, it can be utilized on a big scale, such as in an industrial setting, with sufficient protection.

VII. CONCLUSION

Because of the negative impact that a low power factor can have on a network, it is critical to monitor and maintain the power factor. When the content of harmonics is important, there is not only the danger of unjustified consumption, but also the possibility of damage. The study not only provides a broad overview of power factor and its impact on network performance, but also the dimensioning and practical implementation of a proposed equipment

that enhances a consumer's power factor by connecting capacitors to the power line. Because of the negative impact that a low power factor can have on a network, it is critical to monitor and maintain the power factor. When the content of harmonics is important, there is not only an unjustifiable consumption, but also the danger of injury.

The proposed technology helps the environment while saving money on electricity costs. To improve the system's stability and efficiency, automatic power factor correction procedures can be used in factories, commercial lines, and power distribution networks. Capacitors should not be subjected to quick on-off-on conditions or overcorrection; otherwise, the capacitor bank's lifespan will be drastically reduced. For measurement and monitoring of electrical load, power factor correction equipment based on microcontrollers and capacitor banks was employed, and some deductions were made. Under the test load conditions, the designed power factor correction device was able to improve the power factor from 0.76 to 0.97. The system capacity is released as the current drawn is reduced with the right amount of reactive power compensation. The proposed system constantly analyses the load's power factor and attempts to rectify it. This method can be used in domestic applications to minimize electricity use while also reducing the burden on the grid. To assess the system's performance, we created a variety of scenarios, including automatic and manual modes, to demonstrate and test the system's operation. The results of the real-time measurements are shown on an LCD on the front of the experimental apparatus. The device checks the energy meter automatically and provides home automation via an app that was built, as well as power control. The proposed technology uses less energy and eliminates the need for physical labor. We may obtain monthly energy consumption data straight from a remote site and send it to our central office. This reduces the amount of human work required to record meter readings, which were formerly recorded by visiting each home individually.

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IOT BASED FACE RECOGNITION ACCESS CONTROL

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ABSTRACT

Nowadays, it is important to own a reliable security system that can secure our asset and to protect our privacy. The traditional security system needs an individual to use a key, identification card or password to access a place such as workplace. However, the present security system has many weaknesses. Most doors are controlled by persons with the access of keys, security cards, countersign or pattern to open the door. The aim is to assist users for improvement of the door security of sensitive locations by using face recognition. The proposed system mainly contains a lot of subsystems namely image capture, face detection and recognition, notification and automatic door access management. Face recognition supported by open CV is brought up because it uses Histogram of Gradients (HOG) and reduces the scale of face images without losing vital features, facial images for many persons can be kept in the database. The captured image from camera will be sent to the authorized person for safety purposes.

Keywords— *Identity document, Histogram of Gradients*

I. INTRODUCTION

The most important feature of any home security system is to detect the people who enter or leave the house. Instead of monitoring that through passwords or pins unique faces can be made use of as they are one's biometric trait. These are innate and cannot be modified or stolen easily. The level of security can be raised by using face detection.

The proposed face recognition door lock security system has been developed to prevent robbery in highly secure areas like home environment with lesser power consumption and more reliable stand-alone security device for both Intruder detection and for door security.

In our project the system is powered by Arduino circuit. Arduino electronic board is operated on Battery power supply and wireless internet connectivity. Whenever the person comes in front of the door, it recognizes the face and if it is registered then it unlocks the door, if the face is not registered it will raise an alarm and clicks a picture and send it to the registered number. This is how the system works.

II. LITERATURE SURVEY

As the part of literature survey we referred several IEEE papers. A summary of them are given below:

A. Anti-Spoofing Door Lock Using Face Recognition and Blink Detection

The paper focuses on a method to detect a human face using texture analysis which includes computing a Histogram of Gradients (HOG) over a region of the face and then recognize a face. Face Recognition supported open CV is brought up because it uses Eigen faces and reduces the scale of face images without losing vital features, facial images for many persons can be stored in the database. The captured image from camera will be sent to the authorized person through email for safety purposes. The main aim of the system is to design cost effective, great flexibility by connecting all modules to systems database and open source home automation system using python program for

various home and outdoor environments Haar like features are digital image features used in object recognition for real-time face detector.

B. Automatic Door Lock System by Face Recognition

The In this paper they have proposed face recognition door lock system using arduino for security purpose. Implementation of the system is for monitoring whether any unknown person is entering in to the door. Computer vision is used in the IOT.For security purpose; we have implemented real-time face detection by Haar classifier. Recognizing of faces is done by using cascade classifiers, which gets a high accuracy and will store in the database. For this testing, we have used around 50 images only for each person. A smart IOT based face recognition system is the idea to develop, which identifies the face of the person standing near by the door and compares with the uploaded faces stored in the database.

C. A Face Recognition Attendance System with GSM Notification

The paper focuses on how to create a face recognition attendance system that has the added novelty of relaying outcomes of an attendance taken via a cellular network to designated mobile devices. It provides easy way to take the attendance using face as the biometric. It also has the added novelty of relaying vital information about class attendance to handheld devices Fisher faces algorithm is used. These templates were stored in a database. During the process, facial features extracted from acquired face images and stored picture templates were compared using Fisher Linear Discrimination algorithm for any match within the pre-set threshold. Vital information about collated attendance reports were sent via a cellular network to designated handheld devices. The designed and implemented system had 55.17% accuracy during verification when lighting was varied without any variation in

facial expression during enrollment.

III. METHODOLOGY

A. Block Diagram

The block diagram of the working model is implemented as shown below:
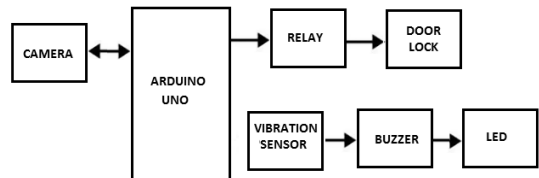
Fig.1: IOT Based Face Recognition System model

B. Working

In this system humans are recognized by their distinctive facial characteristics. In the face recognition approach, a given face is compared with the faces stored in the database in order to detect the person. The goal is to search out a face in the database, which has the highest similarity with the given face. In the field of bioscience, face recognition technology is one among the fastest growing fields. The need of face recognition in security systems is attributed to the rise of commercial interest and therefore the development of feasible technologies to support the development of face recognition. So, face detection is more demanding because of some irregular characteristics, for example, glasses and beard will results in detecting effectiveness. Moreover, different sorts and angles of lighting will make detecting face generate uneven brightness on the face, which will have influence on the detection and recognition process.

The camera captures the face of the person. It creates a database of authorized person if they exist. Whenever a person arrives camera captures the image, save it and compare with the database image. If the image is already stored then it will unlock the

door otherwise it will not unlock the door. Also if anyone tries to enter the room by breaking the door, the vibration sensor detects it and raises an alarm using buzzer. In addition to this the entry time of the people is also set.

IV.   RESULTS AND DISCUSSION

In this project we have mentioned that our system is designed consisting following components such as an Arduino, Vibration Sensor, Camera and a Solenoid Door Lock. The aim was to assist users for improvement of the door security of sensitive locations by using face detection and recognition. The figure below shows the simulated result in which unauthorized person is displayed as unknown and authorized person is displayed with their name. Even if the person is authorized he or she will have to enter an OTP to enter through the door. The figure shows the screen shot of the simulated result.
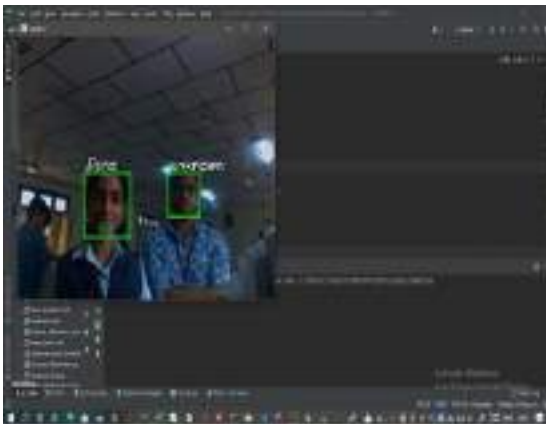
Fig.2: Simulated Result

V.   CONCLUSION

The arrangement of a facial recognition system using arduino can make the system littler, lighter and work successfully utilizing lower control use, so it is more convenient when compare to pc- based face recognition system. Operating system used is Linux, open source software. Entering OTP to unlock the door and sending security alert message to the authorized person utilities inreases the security. Also the time, date and

image of the person will be saved in cloud for further surveillance. We are also providing power backup for the smooth and continuous functioning of the system in the case of power failure.

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EXPERIMENTAL STUDY ON MYCELIUM BRICKS

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ABSTRACT

Construction industry is always one among the top industries in the world. Due to industrialization and associated development of the society the Constructional activities have also increased multifold in number as comparedto the past decades. The construction and demolition lead to increased waste generation and deterioration of environment. Hence it is very necessary to adopt sustainable building practices. Thus, the experimental investigation of mycelium bricks aims to lessen the carbon footprint left by the use of traditional bricks. Organic bricks called mycelium bricks are created from mycelium that has grown on agricultural waste. They have lesser resilience on fossil fuels as compared to conventional bricks. Less to no embodied energy is required for the fabrication of mycelium bricks. The properties of mycelium bricks were analyzed by conducting compressive strength and water absorption tests. The results showed that mycelium bricks can be effectively used as a sustainable construction material.

Key Words: *Construction, Mycelium, sustainable, Environment*

I. INTRODUCTION

Concrete and steel, common building materials, make a sizable contribution to the building industry's major environmental impact. It is necessary to do research on novel materials if the building sector is to meet ambitious environmental targets. One of the intriguing new materials being researched right now is mycelium in the shape of bricks. Mycelium brick is an organic brick made from fungus mycelium and organic waste. Mycelium is a fungi's underground root-like growth that, when dried, can be used as an extremely durable, water, mold, and fire-resistant building material. At room temperature,mycelium will grow. It can naturally develop into a fibrous firm block of mycelium material and feeds on local natural feedstock such husk wheat, maize stock, etc. A new approach to composite materials will be provided by incorporating such natural organism behavior as advancements in architecture and design, paving the way for a more durable future. To createa brick, mycelium fibers are further compressed into a mold and is allowed to expand for a few days. Burning this brick produces mycelium brick, a green building material.

A. Mycelium

A mass of branching, thread-like hyphae make up the mycelium, which is the fungus' root-like structure. Mycelium- based fungi can be found in and on soil as well as many other substrates. Mycelium can serve as a binder when applied to water logging roads, holding up disturbed soil and preventing washouts until woody plants can develop roots. Growing mycelium in agricultural waste can provide substitutes for polystyrene and plastic packaging. Additionally, furniture, bricks, and faux leather have all been made from mycelium.

B. Mushroom Spawns

Spawn, a living fungal culture, is cultivated onto a substrate to produce mycelium. Any operation for producing mushrooms is supported by it. Think of it as

the equivalent of seeds for a mushroom farm. However, unlike seeds, mushroom spawn is developed from chosen genetics and cloned for dependable production of a certain cultivar of mushroom.

C. Enriched saw dust - substrate

Fortified sawdust is also a substrate for mushrooms that is more common in commercial growers than in-house growers. Hardwood sawdust is better than softwood. Also, sawdust must be sterilized before it can settle on mycelium.

D. Hydrogen Peroxide

Hydrogen peroxide is a sanitizing chemical which is used to sterilize the substrate.

E. CaCO3

Calcium carbonate is added to improve the strength of the bricks

II. LITERATURE REVIEW

1. Magdum Rutuja R. et. al. (2020) studied the use of biological growth for the development of environment friendly brick and found that the mycelium content of brick determines its strength. Also, the demolition waste used does not contribute to strength rather it affects the binding of Mycelium; more the percentage of demolition waste more will be the weight and les will be mycelium binding.

2. Banupriya. R, (2018) studied using oyster spawn, as it seemed from current research that it would produce a stronger andstiffer mycelium. From observation, the material's compressive strength seems fair enough. So, these mycelium materials are able to be used in non-load bearing walls. It can be used for internal dividers. The light weight of these bricks reduces the total dead load of the building.

3. Asif Rahman.et. al. (2017) in collaboration with a group of Indian and Italian architects, have shown how to build a pavilion from mushroom mycelium in southwestern India and use this material to create a temporary venue for a large event. They found that the properties of the mycelium fuse with the scaffold to which it was added.

4. Yangang Xing.et. al. (2017) researched a new type of bio insulating material, mycelium. The goal is to produce a mycelial material that can be used as insulation. Bio-based materials had to have properties comparable to existing alternatives such as Styrofoam in terms of physical and mechanical properties, but with improved levels of biodegradability. Test data showed that the mycelium had good thermal performance. Future work is planned to improve mycelial growth and thermal performance.

5. Philip Ross (2014) made a leather-like structure from the root part of mushroom i.e., mycelium. He also made wooden blocks from the same material and are currently testing mushrooms as a building material at a company called Microworks. He made small samples of mycelial bricks using mycelium and agricultural waste grown in his laboratory under a variety of conditions.

III. METHODOLOGY

Mycelium bricks production can be summarized as follows: - As a first step all the raw materials required for production like the mushroom spawns, saw dust, CaCO3, etc., were collected. A brick mold of size 19x9x9 cm was also manufactured for the brick production. The saw dust is to be sterilized before use and for that, it is either steam boiled or we can use 0.2% Hydrogen peroxide for the same. Now mix the contents thoroughly and fill the mold up to the brim of mold. In order to prevent the entry of any kind of contaminants the mold and its contents are to be sealed properly. Finally place the set up in a dark room for about 18 days for the spawn running and binding of mycelium whole throughout evenly. Now the mycelium bricks are ready andplace it in oven for 24 hours at 130ºC to

stop the further growth of mycelium and to obtain the hardened brick.

Type-1

A mushroom bed is prepared which contains the mushroom spawns and saw dust as the substrate. It is kept for about 20- 25 days for the mycelium to grow, propagate, and to complete the spawn running.

a.   Once the mycelium is grown in the mushroom bag, take a brick mold.

b.   Transfer the contents from bed to mold.

c.   Add 30% of CaCO3 to make the brick hard. Wrap the mold in cellophane wrap to make it airtight.

d.   The mold is kept in dark for 15-18 days.

e.   The mycelium spreads evenly, binds together to form a brick.

Fig. 1: Mushroom bed   Fig. 2: Mold filled with bed

Type-2

1.   Mix sterilized saw dust and mushroom spawns evenly.

2.   In order to make the brick hard, CaCO3 was added in different proportions.

3.   Mix proportion is given as saw dust: CaCO3: Mushroom spawn.

4.   Three mix proportions were selected, 5:1.5:1, 5:0.75:1, and 5:0:1

5.   Fill the above mix into an empty mold by hand compaction.

6.   Allow it to grow for 25 days at room temperature.

7.   Mycelium strands fill the empty spaces within 25 days.
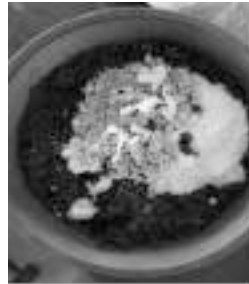
Fig. 3: Mix components   Fig. 4: Sealed mold

After about 18 days, the contents packed and sealed within the mold are transferred into polythene bags. It is necessary because the bed should always be kept moisturized, so any amount of water if needed to be provided can be done at this stage. Also, some provisions or holes are made in the polythene bags for the mushrooms to sprout out.

Fig. 5: Mushroom sprouted   Fig. 6: Oven drying out of mycelium

Fig. 7: Mycelium Bricks (19x9x9) cm

IV.   TESTS

A.   Compressive strength test

Test for compressive strength was conducted on UTM and the average strength obtained was 0.75N/mm2 for type 1 bricks, 3.5 N/mm2 for type 2 bricks (5:0.75:1) and 0.5 N/mm2 for type 2 bricks (5:0:1).

Table 1: Compressive strength test results

Type	Compressive strength (N/mm^2)
Type 1 (mycelium bed)	0.75
Type 2 (5:0.75:1)	3.5
Type 2 (5:0:1)	0.5

B. Water Absorption test

Test for water absorption was conducted on both type 1 and type 2 bricks. The results showed average water absorption of 40% for type 1, 20% for type 2 (5:0.75:1) and 18% for type 2 (5:0:1) bricks.

Table 2: Water absorption test results

Type	Water absorption
Type 1	40%
Type 2 (5:0.75:1)	20%
Type 2 (5:0:1)	18%

V. RESULTS AND DISCUSSIONS

The type 1 (mycelium bed) bricks showed less compressive strength of about 0.75 N/mm2 because of less mycelium propagation and the water absorption observed was relatively higher as mycelium bed as such was used for brick preparation. In case of type 2 bricks with CaCO3, a higher compressive strength (3.5 N/mm2) was observed due to binding capacity of mycelium and due to the presence of CaCO3. They showed a water absorption of about 20% which satisfies the standard conditions. The compressive strength observed in case of type 2 bricks without CaCO3 was about 0.5 N/mm2 and has shown water absorption of about 18% as mycelium layer is almost water proof. From all the above findings we can conclude type

2 bricks (5:0.75:1) as the ideal one which could replace conventional third-class bricks.

VI. CONCLUSION AND FUTURE SCOPE

Mycelium is one of the most promising building materials for the construction industry due to its sustainable building practices. We performed our experimental study on mycelium combined with CaCO3. The results were encouraging. They have got many significant advantages like, no extra energy is needed for their production since they are oven baked, they can be completely recycled, they are highly economical compared to conventional bricks, no special equipment is required for their production. Also, they've got sound strength. Thus, mycelium is capable of revolutionizing world because of its unique properties.

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OBJECT IDENTIFICATION AND RECOGNITION FOR AUTONOMOUS VEHICLES

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ABSTRACT

AI has been using deep learning technology for a number of years now and plays an important role in it. This article focuses deeply on deep learning and how it is involved in detecting and tracking real-world objects. Deep learning tasks with algorithms are influenced by the layout and function of the human brain. The main advantage of working with such algorithms is that performance also increases with increasing input, which is not the case with traditional learning algorithms. Performance is also stable as the amount of data served increases. Real-time object detection is at the heart of some of the hottest topics in computer vision applications. Regardless of the rapid advances made in this area, the efficiency and accuracy of substantial real-time object tracking remains a major challenge. Detection and tracking algorithms are developed based on feature extraction for security and surveillance software. Well-known algorithms for object detection include You Look Only Once (YOLO), Area Based Coherent Neural Network (RCNN), Faster RCNN (F-RCNN). In YOLO, object detection is performed when class probabilities and regression problems are provided for detected images.

Keywords—RCNN, Machine Learning, Artificial Intelligence, YOLO

I. INTRODUCTION

Rapid urbanization has shed light on a multitude of problems, especially in the transport sector, severely restricting travel and posing safety risks. Despite advances in autonomous object detection technology, there are many potential risks and factors for collisions as the cars will be surrounded by an number objects in our everyday life, which includes some moving objects like pedestrians and vehicles also stationary objects like traffic lights and signs. It is therefore essential to quickly recognize distinct static elements and accurately predict the intent of moving objects. The main deep learning methods for object detection problems are divided into two types: 1-step and 2-step algorithms. SSD Yolo is a one-step detection algorithm that converts a detection problem into a uniform regression problem in one step. The one-step method is faster than the two-step method. The two-step method is better than most one-step methods in terms of detection and localization accuracy. The proposed model with multiple tasks in this work is built on single-step process to reduce object detection time. Most researchers use appearance-based features and skeleton-based features in the intent recognition section. In this study, posture estimation technique was used to recognize pedestrian intent. Various references, such as automotive taillights and traffic factors, are used to predict vehicle direction during the vehicle risk assessment step. In addition, the traffic light as an important marker in the traffic scene was identified using the CNN model after the potential traffic lights were filtered out. The main gift of this study can be summarized as follows: The structure is optimized based on the YOLOv4 model in the object detection phase and the computational complexity is greatly reduced while the accuracy is reduced. The Part Affinity Fields approach is fine turned in the pose estimation portion to reduce interface time.

II. RELATED WORKS

A.   Using a Deep Learning-based, detection of road objects with minor appearance in images for autonomous driving in various traffic situations.

Accurate detection of road objects in a variety of conditions greatly improves the safety of autonomous vehicles. On the other hand, the performance of modern algorithms for detecting small objects, poor lighting, and blurry contour road objects in photos is severely limited. This is what we will do to solve these problems. Research based on CenterNet has provided a unique approach to deep learning without anchoring. Threat Space Pyramid Pooling for Improved Detection Performance has been used to extract features at multiple scales without increasing the number of parameters or computational cost. Then, in the proposed solution, we improved the general downsampling procedure by using spatial depth analysis technique. The performance of the proposed approach was tested using a large naturalistic driving data set (BDD100K). Experimental results show that the proposed method can significantly increase the efficiency of detecting small objects in various traffic scenarios.

To overcome the above problems, CenterNet-inspired deep learning system Atrous Spatial Pyramid Pooling (ASPP) CenterNet was introduced. The down sampling module, keypoint estimation network, and output layer were three aspects of the proposed method. The ASPP and space-to-depth modules were used in the downsampling module to downsample the input data and extract multiscale features from the input image. We then used an hourglass-inspired keypoint estimation network as the backbone to predict keypoints and other properties of object size. It was initially designed for efficient wavelet transform calculations by adding zeros between two consecutive filter values along each direction of a typical convolution kernel. Inspired by Spatial Pyramid Pooling, which was first proposed and developed by ASPP, ASPP's success extracts multiscale capabilities at various scales for more accurate and efficient classification. This is desirable for network convergence. As mentioned earlier, the space-to-depth module rearranges the input spatial data blocks to allow stacking of depths. The original hourglass preprocessing network has been removed because the proposed downsampling engine can downsample four input data and extract more fine-grained features. The traditional convolution modules (77 convolutions, stack normalization, and ReLU) and the rest of the modules make up the original preprocessing network.

B.   Autonomous Driving with Deep Modal Object Detection Segmentation

Deep learning drives recent advances in the insight of autonomous driving. Cars are usually Fitted with multiple sensors (cameras, LiDAR, radar, etc.) for robust and accurate scene interpretation, combining multiple sensing modalities to take advantage of their complementary characteristics. Many techniques have been proposed in this area for a wide range of multimodal perceptual difficulties. However, there are no widely accepted standards for the design of network architecture, and the question of what to combine, when to merge, and how to merge remains unresolved. This overview study provides a comprehensive overview of deep multimodal object recognition and segmentation approaches in autonomous driving, investigates the problem. Till now, we gave an outline of all the sensors, datasets, and information for test vehicles on object recognition and segmentation in self driving researches. Next, the fusion approach is summarized and issues and open issues are discussed.

Three problems must be answered when developing a DNN for multi-modal perception: What sensory modalities should

be fused, and how should they be represented and processed appropriately; What fusion techniques should be used; how to fuse When to fuse: when should the sensory modalities be integrated in a neural network during feature representation? We summarise known techniques based on these three factors in this section. The most prevalent sensors used for multimodal perception in the literature are LiDARs, cameras. While deep learning is becoming more popular for processing radar signals, only a few studies have addressed deep multimodal perception with Radar for autonomous driving. As a result, we concentrate on numerous approaches to representing and processing LiDAR pointing clouds and camera images independently, as well as how to integrate them. We also give a brief introduction to radar perception based on deep learning. The vast majority of methods described in the literature we make use of original camera photos or some kind of infrared image. (near-infrared, mid-infrared, or far-infrared) from thermal cameras. Furthermore, some studies extract more sensing data, such as flow of optical depth. Processing LiDAR Points and Camera Images for Deep Multi-Modal insight. Radars use amplitudes, ranges, spectrum to offer detailed information about the surroundings. 2D feature maps can be used to represent radar data, and convolutional neural networks can be used to process it

C. A RGB-D Rooted Object Detection for Autonomous Driving

In autonomous driving, real-time detection of things and the range of road objects are important tasks. This task provides an RGB-D image-based system for detection and range calculation of automobiles, humans, non-electric vehicles, different lanes. Vehicle, pedestrian, and non-electric vehicle detection is classified as a ordinary detection task, multi lane detection is classified as a segmentation task. Use two networks to run these two jobs and improve accuracy and

speed. Introducing a multi-GPU real-time synchronization system that enables training and lane detection and vehicles, as well as human and other detectors. We also offer a centre selection distance measurement element based on binocular distance technology to keep identified objects away. With four 1080Ti GPUs, the machine achieves about 15 frames per second. Creating day and night datasets for these challenges, the algorithm provides very high accuracy. This technology has been tested in China as a real-time system. Investigations have shown that this system can be used for driving activities. DPM performance is improved with traditional object discovery to optimize the effectiveness of the object discovery. 'Girshick' put forward RCNN. This facilitates the development of CNN-based object detection and qualitatively improves the accuracy of object identification. The Region-CNN, which disseminates a 2-step detection strategy, produces several (RoI) before it is classified. Traditional Trace detection methods are inefficient and less robust because they rely on the underlying functionality of handcrafting. In 2015, the first attempt was made to use DL in lane identification. Segmentation rooted on CN-network definition has now become the norm has been very successful. LaneNet translates lane discovery into instance segmentation. To achieve end-to-end training, each lane creates an instance. VPGnet uses a vanishing point training design that uses common spatial structural features rather than a single point short range pixel antenna. Visual image-based distance measurement has long been used in autonomous driving. Nakamura recommends using the true body width of previous vehicle the Kalman filter-based distance estimation approach to make distance measurements with the monocular visual acuity of the previous vehicle. To get an estimate of the distance, Lessmann proposes to input the width and bank angle of different types of front vehicles into the range estimation unit rooted on the Kalmans filter. The process of extracting the L R image corners using the corner extractor, stereo

toning the L R image vertices to obtain target parallax, and thus calculating the range using the concept of triangulation is in binocular section.

III. PROPOSED WORK

Figure 1 shows an overview of the framework proposed in this section. The hazardous variables affecting autonomous driving in real traffic conditions are mainly dynamic objects and stationary objects. The first step is to use the optimized YOLOv4 model to find and recognize a large number of objects. Second, it is important to assess the intent of unprotected road users to perform safe autonomous driving and not causing road accidents, depending on what is observed. In addition, traffic light recognition is an important aspect of autonomous driving, and the safety of autonomous driving directly depends on the precision of this recognition.

A. Process Overview

The main function of the system is object detection, determination of bounding boxes, classification probabilities of each object. On MS COCO dataset, YOLOv4 outperforms all other approaches in terms of detection rate (FPS) and also in detection accuracy (mAP) as a modern object detector. As illustrated in Fig. 2, the YOLOv4 model structure is made up of CSPDarknet-53, SPPnet, PANet, and other three YOLO heads. CSPDarknet, which is the backbone of the only look once algorithm, is responsible to obtain the deepest features of images using C1-C. Each convolutional layer is combined with BN layer and an activation Mesh layer, and this network has 53 convolutional layers with dimensions 11 to 33. In addition, in YOLOv4, all activation functions will modified with ReLU, this requires much less processing. Through various layers of maximum aggregation with SPPnet, the receptive field of the model has been effectively extended. Dimensions, three YOLO heads with dimensions 1919, 3838 and 7676 are thus used to merge also to interact with the feature mapping at different sizes.

Layer pruning is used to modify the structure of the original model to reduce computational complexity. In the Resblock C3-C5 bodies marked in blue, 8 truncated structures in dorsal structure has been removed.

The original YOLOv4 model was mainly modified in this study on the network structure. First, while YOLOv4's network topology improves learning of tiny objects, its detection accuracy for bigger objects is poor IRL tests. This is because after merging objects with low height and height, the weight of objects with height decreases. The confidence of weight for each Yu only look once head is established based on considering the previous loss of reliability algorithms to maintain balance second, compared with YOLOv3, YOLOv4 has about 8% higher MAP, but speed inference is not significantly faster. To reduce parameters of the model, the layer and channel pruning technique is used. The channel reduction strategy reduced the parameters of the entire model by 66% in this test, from 64,363,101 to 21,749,380. Layer pruning strategy used in the backbone component removed 8 structural shortcuts. Only 26% of the original YOLOv4's parameters total in the final simplified model. The test findings indicate that the revised model's inference time is 0.012 seconds quicker than the original model.
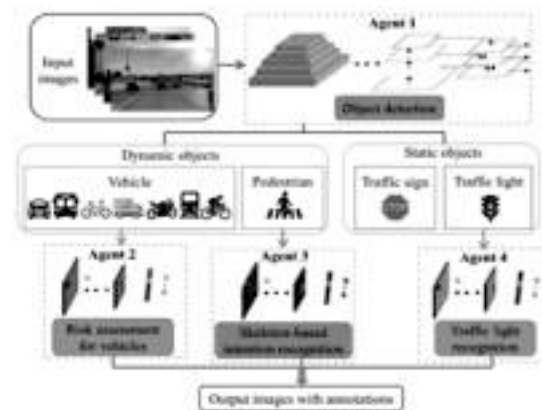

Fig. 1. Flowchart for the suggested framework. The suggested framework consists of four tasks: object identification,

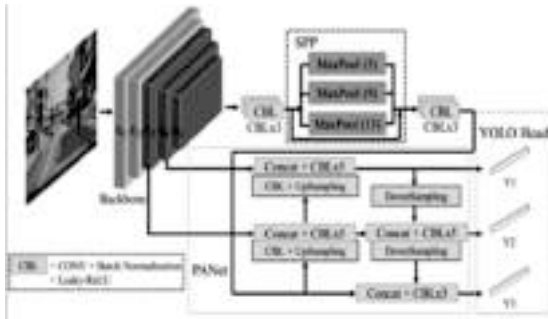vehicle risk assessments and traffic light recognition

Fig. 2. Overall structure of YOLOv4

Furthermore, the dataset BDD100K which is employed during the object finding training phase, and the number of classes varies greatly. For example, the training set contains 714,121 car models, but only 136 train models. YOLO v4 initially used techniques such as cutmix, mixup, Mosaica, and Focal drop algorithms to fix the problem of unbalanced data, but the test results show that the problem persists. To increase the detection precision YOLOv4 photos with a small sample, trains and drivers will be chosen from a training set for extensive training. The photo you select can contain examples from other categories as well as examples from a single category.

IV. CONCLUSION

In this study, a visual sensing and object recognition framework for automatic driving was proposed. The proposed system includes one object recognition task and three recognition tasks. Optimized YOLO4 model with few parameters can detect a variety of objects, achieving higher detection accuracy and processing speed than the original. In the context of autonomous driving of observed objects, vehicles, pedestrians, and traffic lights are crucial. As a result, the relevant subject has three cognitive problems. For each recognition job, the selects the most accurate and optimal model by comparing it to other CNN models. Additionally, we will create a saliency map for each image using the RISE algorithm to demonstrate the categorization outcomes. Future work should focus more on

boosting the gross speed of the suggested framework. With a bespoke pipeline that can effectively handle both single frame-based and multi-frame-based discovery, you can boost the system's performance in the upcoming study. Distance prediction should be incorporated into this framework due to the significance of the distance between the self-driving automobile and another item.

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