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Detection of Cyberbullying Using Machine Learning and Deep Learning Algorithms

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ABSTRACT: Human fingerprints, with their intricate patterns, serve as reliable and unalterable identifiers. These patterns persist unchanged throughout an individual's life, even until death. In various contexts, fingerprint evidence remains a cornerstone, especially in legal proceedings. The minutiae—distinctive features within fingerprints—are highly diverse, with a likelihood of similarity as rare as one in sixty-four thousand million. Remarkably, even identical twins exhibit distinct minutiae patterns. Additionally, the ridge pattern, inherent from birth, remains consistent. This paper proposes a method for person identification by matching minutiae feature patterns extracted from fingerprints. Furthermore, the study explores the correlation between blood groups and fingerprints. The fingerprint matching process involves estimating ridge frequency, while spatial features are extracted using the Gabor filter. Notably, the HFDU06 fingerprint scanner-based approach demonstrates significant efficiency, encompassing tasks such as image-to-binary conversion, thinning, and normalization of fingerprint patterns.

KEYWORDS: Fingerprint pattern, Minutiae, Ridge pattern, Person identification, Blood group, HFDU06 fingerprint scanner.

I. INTRODUCTION

The significance of fingerprint-based work was first demonstrated in a study conducted by Dr. Harold Cummins in 1926, and its existence has been recognized for several centuries. The primary application of fingerprints is the identification of individuals using unique fingerprint patterns. This method is widely used in most organizations in India, not only for identification but also for determining gender and age. The principle of 'you are your own key', which stands against the use of tokens or passwords, is the fundamental concept behind fingerprint identification. Fingerprint-based matching techniques have been in use since the 16th century, with notable work by Henry Fauld in 1880 demonstrating the singularity and uniqueness of fingerprints. The current fingerprint-based identification system was further developed by Herschel. In the 19th century, Sir Francis Galton conducted extensive studies and classified fingerprints based on basic patterns such as loops, whorls, and arches. Cummins coined the term "Dermatoglyphics" (derma = skin, glyphic = carvings) to refer to the dermal ridge patterns on the digits, palms, and soles. He confirmed that these patterns are not solely determined by heredity or inevitable influences that exert constant pressure during their development in fetal life. He also noted that diet and occupation can influence these patterns later in life. A significant advancement in fingerprint pattern recognition was made in 1899 by Edward Henry, who established the "Henry System of Classification". This complex method of classifying fingerprints greatly facilitated manual fingerprinting. By the mid-20th century, fingerprinting was formally recognized as a reliable method of individual identification by law enforcement agencies and became a standard practice in forensic science. Fingerprints are impressions of epidermal ridges, which are formed during the 10th to 16th week of intrauterine life and remain unchanged throughout a person's life. The blood group is another biological characteristic that remains unchanged during a person's lifetime and is used in the diagnostic process to conclude about almost every disease. To determine the blood group and type of disease, a blood sample is required, which is collected by pricking a finger or by injection. The collected blood sample is then mixed with antibodies for results, which may take some time

Researchers are looking into developing a method to predict blood group using fingerprints. This is challenging because fingerprint patterns, which are established in the womb and remain unchanged throughout a person's life, vary greatly between people. Current research hasn't shown a clear link between fingerprints and blood group, or between fingerprints and diseases that come with aging. There are four main fingerprint patterns: loops, whorls, arches, and

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mixed/composite patterns. Loops are the most common, making up about 65% of fingerprints. In a loop, ridges enter from one side of the fingerprint and exit on the same side. Fingerprint features like curves, ovals, diagonals, and circles can be used to identify someone with about 30% accuracy. In the past, researchers have focused on specific fingerprint details to identify individuals. These details were often grouped into five categories: twist, risen twist, whorl, ulnar loop, and elongated loop. A person can have any of these patterns on any of their fingers. Studies show that loops are the most common fingerprint type (70%), followed by whorls (20-25%), and then twists/advanced twists (5-10%). Even identical twins have fingerprint patterns that are similar but not exactly the same. Loops are characterized by ridges that start on one side, curve inwards, and then come out again at the starting point. They usually have one delta and

can open towards the thumb or the little finger. Whorls are the second most common pattern. They have deltas and a central point with a spiral, circle, or other curved pattern. The ridges flow in towards the center and then back out again. Fingerprint patterns are formed due to interactions between the genes and the environment in the womb. The exact causes of these variations are not fully understood, but they are thought to be influenced by factors such as blood flow, pressure on the fetus, and amniotic fluid levels. Despite the variations, fingerprints are still a reliable way to identify individuals because no two people (except identical twins) have exactly the same fingerprints.

II. LITERATURE REVIEW

The process of determining the blood type of an individual involves the interaction of their red blood cells with specific antibody solutions. For instance, if the solution contains anti-B antibodies and the individual's cells have B antigens, agglutination will occur. If the blood does not react to either anti-A or anti-B antibodies, it is classified as blood type O. A series of tests with different types of antibodies are conducted to identify the blood type. If the individual has a blood type, their blood is likely tested against a panel of donor cells that include ABO and RhD antigens. If there is no reaction, donor blood with the same ABO and RhD type can be used. This indicates that the blood has reacted with a specific antibody and is therefore incompatible with blood containing such an antigen. If the blood does not agglutinate, it suggests that the blood does not have antigens opposing the specific reaction in the reagent. In the modern method, the blood type is determined directly. At present, solutions such as anti-A, anti-B, anti-D for the various types of blood have been developed. Over time, agglutination may also occur. Depending on the agglutination, the blood type can be determined by the individual directly. The limitations of this method are that there are higher chances of human errors and only experts can determine the blood type by observing the agglutination process. The preferred method for determining the blood type is usually the plate test and the tube test, both of which are performed using basic methods with human interpretation. In the current era of digitization, it is not a viable method to handle such a simple yet critical scientific process in a completely physical environment. There are also several methods such as microplate testing and gel centrifugation. These advancements in technology have made the process of blood typing more accurate and efficient, reducing the chances of human error and increasing the speed of results. Fernandes and colleagues presented a paper that discussed the development of a device and method for determining the ABO, Rh, reverse, and cross-matching blood types of individuals. The proposed device allows for blood type identification near the patient, outside of a typical laboratory setting, without the need for a specialist to access the blood sample. The device's rapid response time (approximately five minutes) makes it suitable for use in emergency situations, a significant improvement over the traditional methods used in regular labs, which typically have a response time of 30 minutes. The design and validation process for the device is straightforward, without the need for sample dilution or incubation periods.

The device, constructed with simple, readily available materials, distinguishes between agglutinated and non-agglutinated samples using a game theory algorithm developed by the authors. This algorithm considers the distribution of optical density (OD) discrete values for each blood sample. The device's operation was validated for ABO, Rh, reverse, and cross- matching human blood typing based on donor blood type data provided by the IPST. The results agreed with their classification using their commercial and modified methods. S. Pimenta and colleagues are working on the development of modified and reduced devices for smart applications. One focus of this work is the development of a reduced, low-cost, flexible, and modified system for blood typing in emergency situations. This system uses a spectrophotometric method and internal agglutination (interaction between the surface of red blood cells and specific reagents). The use of a reliable and fast experimental setup allows for blood type determination and facilitates the creation of a customized system. This system is likely to overcome significant obstacles of the superior methods and systems for blood typing. The results can be influenced by various factors that make the development of an improved

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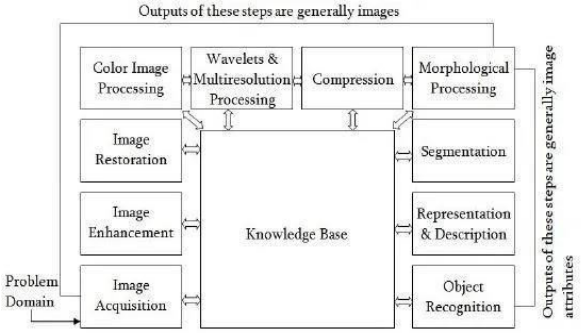
system more complex. These factors include the basic setup used for spectrophotometric measurements; the agglutination stimulus, which affects the boundaries between direct and indirect readings; the time spent in the transparency limit since it is directly proportional to blood and reagents mixing; and the complete spectra reading as soon as possible because the agglutinated cells will generally settle in the bottom part of the cuvette.Proposed approach with the guide of using Fernandes et al. used spectrophotometric approach for identifying rh blood groups. This check may be identified with the bendy system beginning past due made with the manual of using the check expense for picking a, b and o blood groups. This paper also provides in depth study of rh regularly support, in which various antegens such as e, c, c, d and e are separated to appearance an agglutinated examine (advised test among antigens and antibodies) from a non- agglutinated appraisal (no affiliation). To choose out the closeness or nonappearance of each antigen five designs have been fame quo name for with the guide of utilizing putting 50 f. Ll of the amazing reagent and 12. Five f. Ll of complete blood withinside the plate, as depicted with inside the reagents control. Every redirection association modified over into joined for cycle one 2d in a detail of two. 5 cm2. By at that point, the plate changed over into suggested with inside the looking over set-up of the spectrophotometer.

Tejaswini et al. proposed a method that involves capturing images of slide tests using a modified digital camera. These images, which are generated by the interaction of blood and reagent, are processed using MATLAB software. The image processing techniques such as precise plane extraction, thresholding, and morphological operations are applied to the



images. After applying auto thresholding, it is observed that the size and object are removed, resulting in a clear image. Subsequently, a pixel- wise threshold is applied using Niblack's method, which results in a boundary delineated image. The separated image is then compressed using edge morphology. Advanced morphological operation Opening is applied to smoothen the contours of cells by removing small objects. The images are then processed using color plane extraction HSL luminance plane and authenticated parts. Finally, the blood type is determined. The use of image processing technique allows for automated detection of agglutination and determines the blood type of the individual in a short span of time. This device is simple and useful in emergency situations. Keerthana. D et al. developed an embedded system that uses an Image processing algorithm to perform blood type determinations. This system allows us to determine the blood type of an individual by reducing the constraints related to the availability of the donor, reducing the response risks, and the limitation of the final product without human errors. This paper focuses on reducing human intervention and performing large-scale tests independently from the extraction of antigens to the smooth generation of the final results. It provides the results in a reasonable time frame with accuracy and precision along with the limitation of the final product for future references. Implementing an efficient system eliminates potential errors and ensures that the right test is performed on the right sample, the right results are obtained, and the right blood type is provided to the right individual at the right time. The proposed device deals with the cost of the game association and uses a smart, more affordable system that provides the necessary information needed for the study at a reduced cost and the highly trained professionals are not required

III. PROPOSED METHODOLOGY

The research proposed herein is centered on the development of a novel machine capable of establishing a correlation between an individual's blood pressure and the intricate details of their fingerprints. The ultimate goal of this machine is to predict a person's blood pressure based solely on their fingerprints. To achieve this, fingerprints are

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$$recall = \frac{true\ positives}{true\ positives\ + false\ negatives}$$

collected from a diverse range of individuals spanning various age groups and geographical regions. This collection process employs an optical fingerprint scanner, specifically the HFDU06 model, to capture the fingerprint data. This comprehensive data collection effort involves scanning all fingers of each individual to amass a robust dataset for model training. In addition to fingerprint data, various other data points are collected via a basic registration form. These data points encompass external factors such as age, weight, height, skin tone, eye color, nature of work, dietary habits (i.e., vegetarian or non- vegetarian), location (i.e., rural or urban), and lifestyle habits (e.g., drinking, smoking, etc.). Once collected, the fingerprint data undergoes a series of pre-processing stages aimed at enhancement and noise removal prior to feature extraction. These stages include segmentation, normalization, orientation estimation, ridge frequency estimation, Gabor filtering, binarization, and thinning. It should be noted that the steps of orientation estimation and ridge frequency estimation are optional and can be performed if deemed necessary. This pre- processing procedure is repeated for each individual's fingerprint to create a diverse dataset for model training. The collected data, in conjunction with the external factors recorded through the basic registration form, are utilized to enhance the accuracy of the prediction model. Finally, the pre-processed fingerprint data undergoes the same stages of enhancement and noise removal before feature extraction. This ensures the highest quality data is used for the prediction model, thereby maximizing its predictive accuracy. This research represents a significant stride in the field of biometric-based health prediction systems.

Chi square analysis

The Chi square analysis result of captured data shown as follows:

x Ha: There is an association Between Gender and Blood Group

x H0: There is no association between Gender and Blood Group

The chi square= 0.64619 and Df = 3. Also, the pvalue=0.8850 is obtained by chi square analysis, where $p < 0.05$, then Null Hypothesis is rejected.

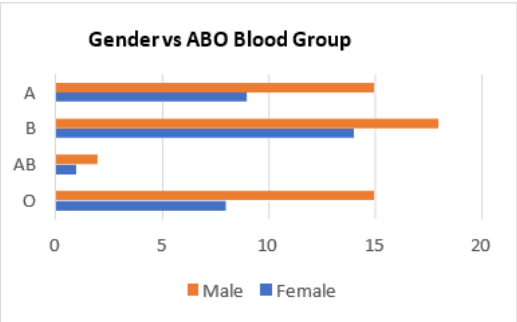

Figure 3: Gender vs ABO Blood Group

B. MULTIPLE LINEAR REGRESSION ANALYSIS

The OLS Multiple Linear Regression method used for prediction or finding the association between blood group and feature extracted from fingerprint image. The Ordinary Least Squares regression (OLS) is more frequently called linear regression. The linear regression is considered as single type or multiple type based on number of variables in the regression analysis.

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OLS Regression Results

Dep. Variable:	y	R-squared (uncentered):	0.775
Model:	OLS	Adj. R-squared (uncentered):	0.757
Method:	Least Squares	F-statistic:	42.11
Date:	Mon, 30 Mar 2020	Prob (F-statistic):	5.87e-48
Time:	20:58:40	Log-Likelihood:	-133.96
No. Observations:	185	AIC:	295.9
Df Residuals:	171	BIC:	341.0
Df Model:	14		
Covariance Type:	nonrobust		

Figure 4: Summary of Multiple Linear Regression Model

The fig. 4 shows the summary of Summary of Multiple Linear Regression Model based on Ordinary Least Squares, which show R - Square value is 775 which may be biased but Adj. R - Square value is 757 which suggest model fit in average to predict blood group from extracted values shown Table 3. Whereas the fig 5 shows summary of features used to fit the OLS multi valued regression model.

	coef	std err	t	P>|t|	[0.025	0.975]
x1	0.0063	0.005	1.234	0.219	-0.004	0.016
x2	0.1129	0.085	1.332	0.185	-0.054	0.280
x3	1.3979	3.203	0.436	0.663	-4.926	7.721
x4	-0.0053	0.003	-1.622	0.107	-0.012	0.001
x5	0.2730	0.186	1.469	0.144	-0.094	0.640
x6	0.1834	0.114	1.608	0.110	-0.042	0.409
x7	-0.0330	0.112	-0.295	0.768	-0.254	0.188
x8	0.0019	0.001	1.618	0.107	-0.000	0.004
x9	-0.0025	0.001	-2.414	0.017	-0.005	-0.000
x10	0.0619	0.170	0.363	0.717	-0.275	0.398
x11	-0.1280	0.342	-0.374	0.709	-0.803	0.547
x12	0.0463	0.026	1.815	0.071	-0.004	0.097
x13	-0.1423	0.059	-2.415	0.017	-0.259	-0.026
x14	0.0910	0.042	2.173	0.031	0.008	0.174

Omnibus:	1.672	Durbin-Watson:	0.528
Prob(Omnibus):	0.433	Jarque-Bera (JB):	1.628
Skew:	-0.227	Prob(JB):	0.443
Kurtosis:	2.928	Cond. No.	1.34e+05

Figure 5: Features used to fit the OLS regression model

$$F_1 = 2 * \frac{precision * recall}{precision + recall}$$

Predicted		Positive	Negative
	True	40	10
	False	15	18

C. ACCURACY, PRECISION, AND RECALL

Recall estimation provides the understanding of accurate classification or predictions performed by the model developed for considered dataset.

recall = 40/ (40+18) = 0.689

The precision estimation and its analysis provides the view of how much dataset based predictions are more appropriate.

precision=40/ (40+15) = 0.727 x

Along with precision and recall, F1 score is also estimated to identify the harmonica mean which is given by,

F1=2*(0.727*0.689)/ (0.727+0.689) = 0.707

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IV. CONCLUSION AND FUTURE WORK

The method of biometric identification using fingerprints demonstrates significant stability, making it a potential candidate for various applications. The current research introduces an effective technique for identifying blood groups. Fingerprints, which possess numerous unique minutiae features, are utilized to predict blood groups using various machine learning methods. The proposed system employs Multiple Linear Regression with Ordinary Least Squares (OLS) to predict blood groups, achieving an accuracy of 62%. For future studies, it is suggested to increase the sample size to enhance the accuracy of the results. Additionally, consideration should be given to additional fingerprint features that have not yet been taken into account. Please note that this information is based on the original text and may need to be updated with the most recent research findings

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