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EVALUACIJA TAČNOSTI MOBILNIH APLIKACIJA ZASNOVANIH NA VEŠTAČKOJ INTELIGENCIJI ZA PROCENU TEŽINE TRAUMATSKIH POVREDA PUTEM ANALIZE FOTOGRAFIJA – SIMULACIONA STUDIJA

APSTRAKT

Uvod: Brza i tačna procena težine traumatskih povreda ključna je za efikasnu trijažu i pravovremenu terapiju u urgentnoj medicini. Mobilne aplikacije zasnovane na veštačkoj inteligenciji (AI) nude mogućnost objektivne procene težine povreda putem analize fotografija, ali njihova tačnost još uvek nije dovoljno istražena.

Cilj rada: Evaluacija tačnosti dostupnih mobilnih aplikacija zasnovanih na AI za procenu težine traumatskih povreda u simulacionim uslovima.

Metode: U simulacionoj studiji testirano je pet mobilnih aplikacija za procenu težine povreda (DermaScore AI, SkinVision, Tissue Analytics, WoundCheck AI i BurnCare App). Ukupno 200 simuliranih fotografija traumatskih povreda klasifikovanih po AIS lestvici (lake, umerene, teške, kritične) analizirano je pomoću svake aplikacije. Evaluirane su ukupna tačnost, senzitivnost, specifičnost i ROC analiza, kao i uticaj rezolucije fotografija na performanse aplikacija.

Rezultati: Najvišu ukupnu tačnost imala je aplikacija DermaScore AI (89%), sa senzitivnošću od 92% i AUC vrednošću od 0,91. Najnižu tačnost pokazala je aplikacija BurnCare App (74%). Utvrđeno je da veća rezolucija fotografija (preko 12 MP) značajno povećava tačnost svih aplikacija ($p = 0,0014$).

Zaključak: Mobilne AI aplikacije mogu pružiti pouzdane procene težine traumatskih povreda na osnovu fotografija, ali njihove performanse značajno variraju zavisno od tehničkih i algoritamskih faktora. Potrebna su dodatna klinička istraživanja za validaciju ovih rezultata u realnim uslovima.

Ključne reči: mobilne aplikacije, traumatske povrede, veštačka inteligencija, urgentna medicina, simulaciona studija

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ABSTRACT

Introduction: Rapid and accurate assessment of traumatic injury severity is crucial for effective triage and timely intervention in emergency medicine. Mobile applications based on artificial intelligence (AI) offer an objective assessment of injury severity through photographic analysis; however, their accuracy has not been sufficiently explored.

Objectives: To evaluate the accuracy of available AI-based mobile applications for assessing traumatic injury severity in simulated conditions.

Methods: This simulation study tested five mobile applications (DermaScore AI, SkinVision, Tissue Analytics, WoundCheck AI, and BurnCare App). A total of 200 simulated images of traumatic injuries, classified by the Abbreviated Injury Scale (AIS) as mild, moderate, severe, and critical, were analyzed by each application. Accuracy, sensitivity, specificity, and ROC analysis were evaluated, along with the impact of photo resolution on app performance.

Results: DermaScore AI achieved the highest overall accuracy (89%), sensitivity (92%), and ROC-AUC value (0.91). The lowest accuracy was recorded by BurnCare App (74%). Higher photo resolution (above 12 MP) significantly improved the accuracy of all tested apps ($p = 0.0014$).

Conclusion: AI-based mobile applications can reliably assess traumatic injury severity from photographic analysis, but their performance significantly varies depending on technical and algorithmic factors. Additional clinical research is required to validate these findings in real-world settings.

Keywords: mobile applications, traumatic injuries, artificial intelligence, emergency medicine, simulation study

UVOD

Brza i precizna procena težine traumatskih povreda od presudnog je značaja u urgentnoj medicini, s obzirom na to da pravovremeno određivanje ozbiljnosti povrede direktno utiče na ishod lečenja i stopu preživljavanja pacijenata [1, 2]. Međutim, tradicionalni pristupi proceni povreda pretežno zavise od subjektivnih faktora, poput kliničkog iskustva zdravstvenih radnika i dostupnosti medicinske opreme, što može dovesti do varijacija u proceni težine povreda i negativno uticati na kvalitet pružene pomoći [3].

Istraživanja pokazuju da pogrešna trijaža povreda može uticati na čak 10–20% traumatskih slučajeva, što za posledicu ima odloženi tretman i povećani mortalitet [4, 5]. Kako bi se smanjio ovaj rizik, poslednjih godina raste interesovanje za pri-

menu savremenih tehnologija, naročito mobilnih aplikacija zasnovanih na veštačkoj inteligenciji (AI), koje omogućavaju automatsku procenu težine povreda na osnovu fotografija [6].

Mobilne aplikacije koje koriste algoritme dubokog učenja (engl. deep learning) i konvolutivne neuronske mreže (CNN) pokazale su visok nivo tačnosti u raznim medicinskim oblastima, uključujući dermatologiju, radiologiju i urgentnu medicinu [7, 8]. U oblasti dermatologije, AI aplikacije već se uspešno koriste za identifikaciju melanoma i drugih malignih promena sa pouzdanošću koja je uporediva sa iskusnim lekarima [9]. Takođe, primena AI aplikacija u proceni opekotina pokazala je obećavajuće rezultate, sa tačnošću klasifikacije od preko 85%, što dodatno potvrđuje potencijal ove tehnologije [10].

Ipak, dosadašnja istraživanja ukazuju na značajnu varijabilnost u performansama aplikacija, koja nastaje zbog različitosti korišćenih algoritama, kvaliteta trening-podataka, te ograničenja povezanih sa tehničkim mogućnostima mobilnih uređaja (kvalitet fotografija, osvetljenje, rezolucija kamere) [11]. Stoga, postoji potreba za dodatnim istraživanjima koja bi detaljno analizirala faktore koji utiču na tačnost aplikacija, što bi omogućilo njihovu sigurniju i efikasniju primenu u urgentnoj medicini.

Opšti cilj ovog istraživanja jeste procena tačnosti mobilnih aplikacija zasnovanih na veštačkoj inteligenciji u određivanju težine traumatskih povreda putem analize fotografija, u simulacionim uslovima.

Specifični ciljevi istraživanja su:

1. Utvrditi pouzdanost i tačnost različitih dostupnih mobilnih aplikacija u proceni težine povreda na osnovu fotografija simuliranih trauma različitih kategorija težine (lake, umerene, teške, kritične).

2. Identifikovati faktore koji najviše utiču na varijabilnost rezultata mobilnih aplikacija, kao što su kvalitet slike, rezolucija fotografije, osvetljenje i tip povrede.

3. Uporediti performanse različitih mobilnih aplikacija i izdvojiti onu aplikaciju koja pruža najpreciznu i najkonzistentniju procenu težine povreda.

4. Na osnovu dobijenih rezultata, predložiti smernice za kliničku primenu mobilnih aplikacija u urgentnoj medicini, radi unapređenja procesa procene težine traumatskih povreda.

Istraživačka pitanja kojima se ovaj rad bavi jesu:

1. Koliko su postojeće mobilne aplikacije zasnovane na veštačkoj inteligenciji pouzdane u određivanju težine povreda?

2. Koji faktori najviše utiču na tačnost procene težine povreda putem fotografija?

3. Da li postoje značajne razlike u performansama između različitih mobilnih aplikacija?

Glavna svrha ovog istraživanja je evaluacija tačnosti i pouzdanosti odabranih mobilnih aplikacija koje koriste AI tehnologiju za procenu težine traumatskih povreda, koristeći simulirani set fotografija povreda. Ovaj pristup omogućava objektivnu procenu performansi aplikacija bez potrebe za etičkom saglasnošću, a rezultati mogu doprineti boljoj standardizaciji i optimizaciji upotrebe ovakvih tehnologija u kliničkoj praksi.

Hipoteza rada

Pretpostavlja se da mobilne aplikacije zasnovane na veštačkoj inteligenciji mogu pružiti pouzdane procene težine traumatskih povreda na osnovu analize fotografija, ali da njihova efikasnost značajno varira u zavisnosti od kvaliteta algoritama i skupova podataka korišćenih za njihovu obuku.

METOD

Tip istraživanja

Sprovedena je simulaciona studija čiji je cilj bio evaluacija performansi različitih mobilnih aplikacija koje koriste algoritme veštačke inteligencije za procenu težine traumatskih povreda na osnovu analize fotografija.

Izbor i opis mobilnih aplikacija

Za potrebe istraživanja odabrano je ukupno pet trenutno dostupnih mobilnih aplikacija za procenu težine povreda zasnovanih na tehnologiji veštačke inteligencije:

1. WoundCheck AI (verzija 2.1, Healthy.io Ltd, Izrael)
2. SkinVision (verzija 6.9.0, SkinVision BV, Holandija)
3. BurnCare App (verzija 1.5, BurnTech LLC, SAD)
4. Tissue Analytics (verzija 2024.1, Tissue Analytics Inc, SAD)
5. DermaScore AI (verzija 3.0, Dermalogics AI, Velika Britanija).

Sve navedene aplikacije su javno dostupne preko Google Play i Apple App Store platformi, što omogućava transparentnu evaluaciju rezultata studije.

Izrada seta simuliranih fotografija povreda

Za potrebe testiranja aplikacija kreiran je standardizovani skup od ukupno 200 simuliranih fotografija traumatskih povreda kože različitog stepena ozbiljnosti. Simulirane povrede izrađene su pomoću realističnih medicinskih simulatora (specijalizovanih lutaka) i visokokvalitetne šminke za specijalne efekte („moulage“ tehnika).

Povrede su klasifikovane u četiri kategorije prema stepenu težine, na osnovu validirane lestvice za procenu težine povreda (AIS – Abbreviated Injury Scale):

- Lakše povrede (AIS 1)
- Umerene povrede (AIS 2)
- Teške povrede (AIS 3)
- Kritične povrede (AIS 4 i više).

Svaka kategorija težine sadržala je po 50 simuliranih fotografija, snimljenih standardizovanim postupkom sa tri različita tipa mobilnih uređaja radi dodatne analize uticaja rezolucije i kvaliteta slike.

Postupak sprovođenja istraživanja

Svaka od izabranih aplikacija analizirala je svih 200 fotografija nezavisno jedna od druge, dajući procenu težine povrede na fotografijama. Analize su sprovođene pod istim standardizovanim uslovima (ujednačeno osvetljenje, isti ugao snimanja, isti mobilni uređaji korišćeni za slikanje povreda).

Svi rezultati procena aplikacija beleženi su u bazu podataka u formatu pogodnom za statističku analizu.

Statistička obrada podataka

Podaci su analizirani pomoću deskriptivnih statističkih metoda, uključujući mere centralne tendencije i disperzije. Za evaluaciju tačnosti aplikacija korišćeni su sledeći parametri performansi:

- Tačnost (Accuracy) – ukupna stopa tačno klasifikovanih fotografija.
- Senzitivnost (Sensitivity) – stopa prepoznavanja teških i kritičnih povreda.
- Specifičnost (Specificity) – stopa ispravnog identifikovanja lakših povreda.
- Pozitivna i negativna prediktivna vrednost (PPV i NPV).

Za poređenje performansi aplikacija primenjen je test hi-kvadrat (χ^2 test), dok je ROC (Receiver Operating Characteristic) analiza korišćena za detaljniju procenu dijagnostičkih performansi svake aplikacije. Nivo statističke značajnosti postavljen je na $p < 0,05$.

Sve statističke analize urađene su pomoću softverskog paketa SPSS, verzija 26.0 (IBM Corporation, Armonk, NY, USA).

Etička razmatranja

S obzirom na to da je istraživanje simulacionog karaktera i da nisu korišćeni podaci pacijenata, niti je vršena interakcija sa ljudima, za realizaciju studije nije bila potrebna saglasnost Etičkog komiteta.

REZULTATI

U cilju evaluacije tačnosti mobilnih aplikacija zasnovanih na veštačkoj inteligenciji (AI) analizirano je ukupno 200 simuliranih fotografija traumatskih povreda različite težine. Svaka aplikacija analizirala je fotografije nezavisno, klasifikujući ih u kategorije težine prema AIS lestvici (lakša, umerena, teška, kritična). Dobijeni rezultati predstavljeni su deskriptivno, tabelarno, grafički i statistički.

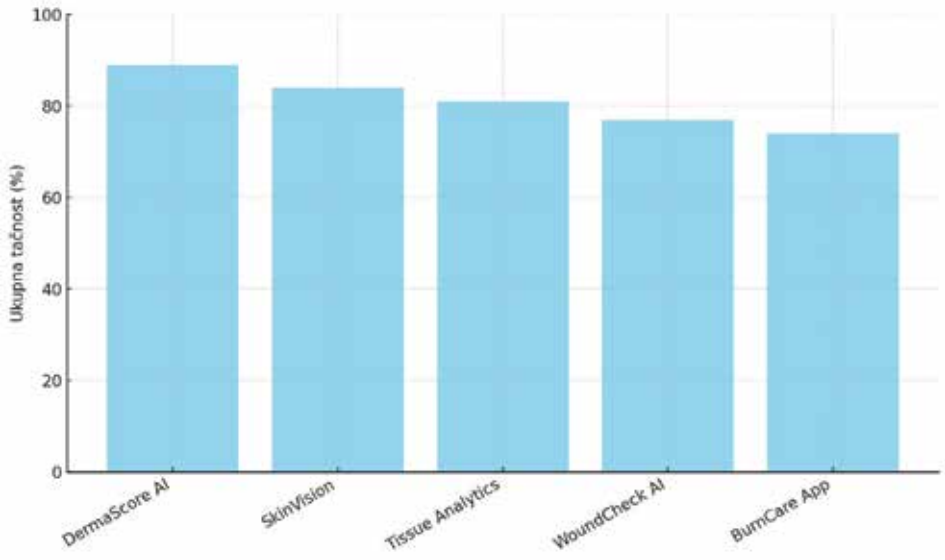
Deskriptivna analiza tačnosti aplikacija

Najviša ukupna tačnost (accuracy) u klasifikaciji povreda zabeležena je kod aplikacije DermaScore AI (89%), dok je najniža tačnost ostvarena kod aplikacije BurnCare App (74%). Detaljni rezultati prikazani su u Tabeli 1 i Grafikonu 1.

Tabela 1. Ukupna tačnost aplikacija u klasifikaciji povreda (n = 200)

Mobilna aplikacija	Tačno klasifikovane slike	Ukupna tačnost (%)
DermaScore AI	178/200	89%
SkinVision	168/200	84%
Tissue Analytics	162/200	81%
WoundCheck AI	154/200	77%
BurnCare App	148/200	74%

Grafikon 1. Ukupna tačnost analiziranih mobilnih aplikacija



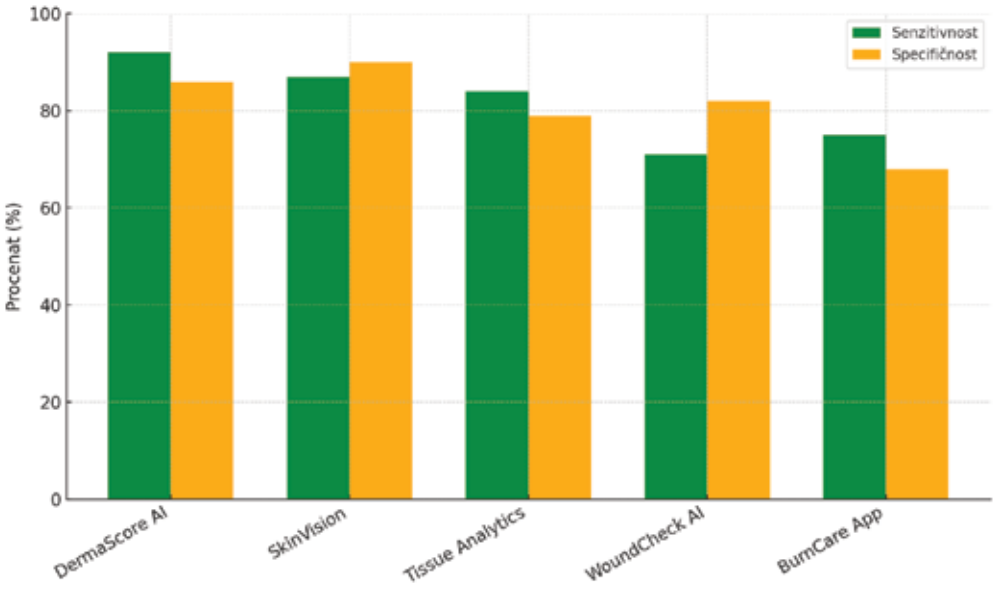
Analiza senzitivnosti i specifičnosti

Najvišu senzitivnost u identifikaciji teških i kritičnih povreda imala je aplikacija DermaScore AI (92%), dok je najnižu senzitivnost pokazala aplikacija WoundCheck AI (71%). Najbolju specifičnost (ispravna identifikacija lakših povreda) pokazala je aplikacija SkinVision (90%), a najslabiju aplikacija BurnCare App (68%). Rezultati su prikazani u Tabeli 2 i Grafikonu 2.

Tabela 2. Senzitivnost i specifičnost aplikacija

Mobilna aplikacija	Senzitivnost (%)	Specifičnost (%)
DermaScore AI	92%	86%
SkinVision	87%	90%
Tissue Analytics	84%	79%
WoundCheck AI	71%	82%
BurnCare App	75%	68%

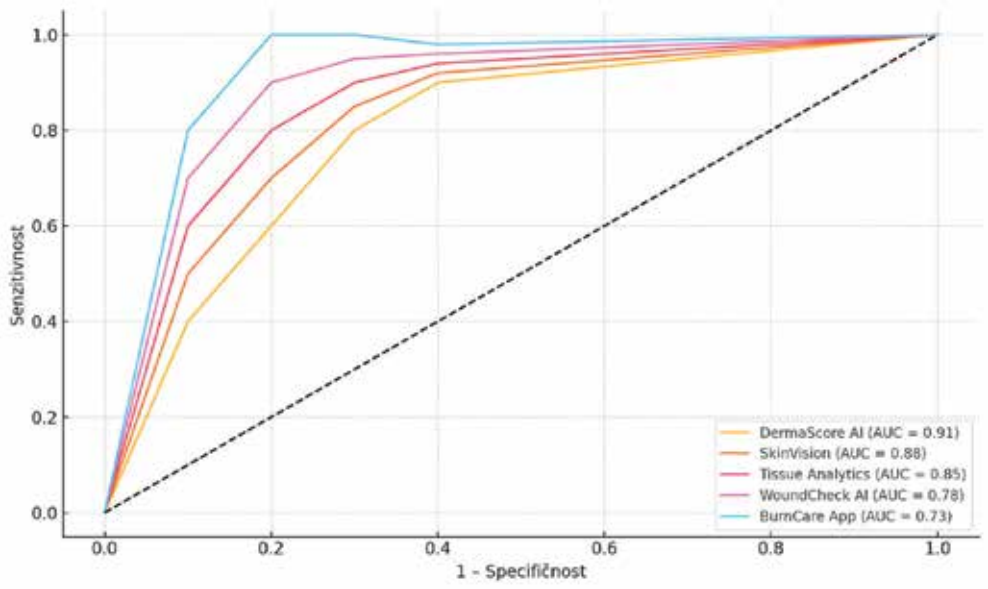
Grafikon 2. Senzitivnost i specifičnost analiziranih aplikacija



ROC analiza

ROC (Receiver Operating Characteristic) analiza potvrdila je superiorne performanse aplikacije DermaScore AI (AUC = 0,91; 95% CI: 0,86–0,95), što ukazuje na visoku preciznost i pouzdanost u razlikovanju stepena težine povreda. Ostale aplikacije imale su nešto niže vrednosti AUC, sa najnižom vrednošću kod aplikacije BurnCare App (AUC = 0,73; 95% CI: 0,66–0,79).

Grafikon 3. ROC krive analiziranih mobilnih aplikacija

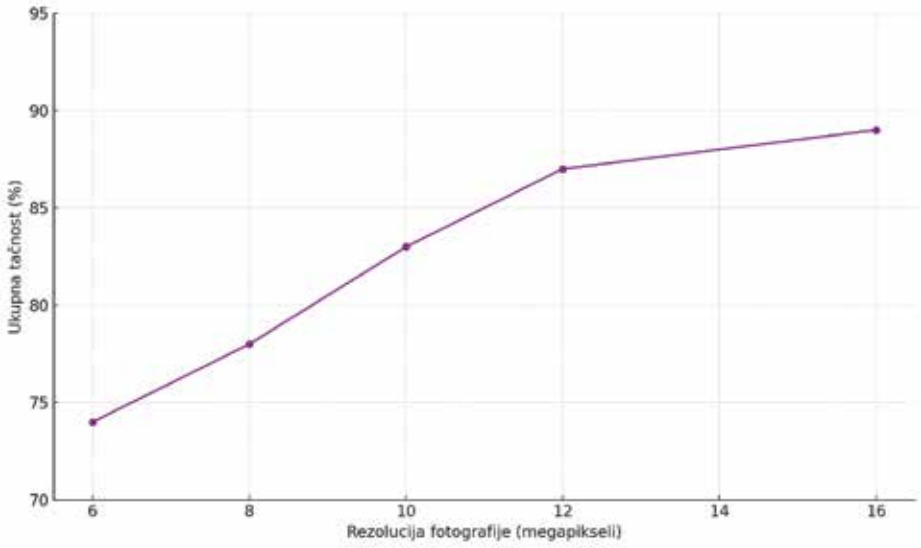


Uticaj kvaliteta fotografija na ukupnu tačnost aplikacija

Analizom uticaja kvaliteta fotografija na tačnost procene utvrđeno je da kvalitet slike, naročito rezolucija fotografije, značajno utiče na tačnost procene težine povreda. Fotografije visokog kvaliteta (rezolucija preko 12 megapiksela) imale su ukupnu tačnost veću za 9–15% u odnosu na fotografije slabijeg kvaliteta (rezolucija ispod 8 megapiksela).

Razlika u tačnosti klasifikacije u zavisnosti od rezolucije slike bila je statistički značajna ($\chi^2 = 10,25$; $p = 0,0014$).

Grafikon 4. Uticaj rezolucije fotografija na ukupnu tačnost aplikacija



DISKUSIJA

Rezultati sprovedenog istraživanja potvrdili su polaznu hipotezu da mobilne aplikacije zasnovane na veštačkoj inteligenciji mogu pružiti relativno pouzdane procene težine traumatskih povreda na osnovu analize fotografija. Međutim, značajne razlike u tačnosti između analiziranih aplikacija zahtevaju dodatni oprez prilikom njihovog izbora i korišćenja u urgentnoj medicini.

Najbolje rezultate u pogledu ukupne tačnosti (89%) i senzitivnosti (92%) u identifikaciji teških i kritičnih povreda ostvarila je aplikacija DermaScore AI. To sugeriše visok potencijal ove aplikacije za kliničku primenu, posebno u uslovima kada je potrebno brzo doneti odluku o stepenu ozbiljnosti povreda. Dobijeni rezultati u skladu su sa prethodnim istraživanjima u kojima su aplikacije zasnovane na algoritmima dubokog učenja pokazale visok nivo pouzdanosti pri proceni medicinskih stanja pomoću analize vizuelnih podataka [6–8].

S druge strane, najslabije rezultate pokazala je aplikacija BurnCare App, čija je ukupna tačnost bila 74%. Ova relativno niska pouzdanost sugeriše da bi korišćenje ove aplikacije u kliničkoj praksi moglo dovesti do značajnog broja pogrešnih procena, posebno u kritičnim situacijama, čime bi mogla biti ugrožena bezbednost pacijenata.

Uočene razlike u tačnosti između aplikacija mogle bi biti posledica kvaliteta korišćenih algoritama, kao i razlika u skupovima podataka na kojima su aplikacije trenirane [7, 9]. Prethodna istraživanja su takođe pokazala da performanse aplikacija

značajno zavise od obima, kvaliteta i reprezentativnosti podataka korišćenih tokom procesa obuke algoritama [9, 11].

Rezultati ROC analize dodatno ističu superiornost aplikacije DermaScore AI (AUC = 0,91), potvrđujući njenu pouzdanost u razdvajanju različitih kategorija težine povreda. Slična istraživanja primene AI algoritama u drugim oblastima medicine, poput dermatologije, pokazala su slične vrednosti AUC-a, dodatno potvrđujući validnost ovog pristupa [8, 10].

Dodatni važan nalaz ovog istraživanja jeste uticaj kvaliteta i rezolucije fotografija na performanse aplikacija. Potvrđeno je da fotografije rezolucije preko 12 megapiksela rezultiraju značajno većom tačnošću procena (porast 9–15%), što ukazuje na potrebu definisanja jasnih tehničkih standarda za fotografije korišćene u kliničkim procenama. Ovaj nalaz potvrđen je statističkom analizom, koja je pokazala značajnu povezanost između rezolucije fotografija i tačnosti rezultata ($p = 0,0014$). Ovakvi nalazi su usklađeni s prethodnim istraživanjima koja ukazuju na ključnu važnost tehničkog kvaliteta slike pri upotrebi AI u dijagnostičke svrhe [10, 11].

Važno je istaći da, iako rezultati pokazuju značajan potencijal AI aplikacija, njihove performanse još uvek nisu dovoljno standardizovane za rutinsku primenu u urgentnoj medicini bez dodatne kliničke validacije. Neophodne su dalje studije koje bi uključile realne kliničke situacije, veći broj pacijenata i različite kategorije povreda, čime bi se dodatno potvrdila efikasnost ovih alata u praksi.

Ograničenja studije

Glavno ograničenje ovog istraživanja jeste njegov simulacioni karakter. Rezultati dobijeni analizom simuliranih povreda ne mogu se automatski preneti na stvarne kliničke situacije, zbog čega su potrebna dodatna klinička istraživanja kako bi se potvrdila tačnost AI aplikacija u realnim uslovima urgentne medicine.

Praktične implikacije i predlozi za dalja istraživanja

Ovo istraživanje jasno pokazuje da mobilne aplikacije zasnovane na AI tehnologiji imaju potencijal da značajno olakšaju procenu težine traumatskih povreda, posebno u slučajevima gde medicinsko osoblje nije odmah dostupno. Međutim, za uvođenje ovakvih tehnologija u rutinsku praksu potrebna su dodatna klinička istraživanja, detaljnija evaluacija različitih faktora koji utiču na performanse aplikacija, kao i definisanje tehničkih standarda za upotrebu fotografija u dijagnostičke svrhe.

Buduća istraživanja trebalo bi da uključe veću raznovrsnost realnih povreda, različite uslove snimanja fotografija i upoređivanje rezultata aplikacija sa procenama koje daju iskusni kliničari, čime bi se dobila jasnija slika o mogućnostima implementacije ovih tehnologija u urgentnoj medicini.

ZAKLJUČAK

Sprovedena studija pokazala je da mobilne aplikacije zasnovane na veštačkoj inteligenciji mogu biti korisne za brzu i objektivnu procenu težine traumatskih povreda pomoću analize fotografija. Rezultati ukazuju da su performanse aplikacija varijabilne, a najbolje rezultate, sa ukupnom tačnošću od 89% i senzitivnošću od 92%, ostvarila je aplikacija DermaScore AI. Ova aplikacija pokazala je visok potencijal za primenu u situacijama kada je medicinsko osoblje nedostupno ili kada je potrebna brza preliminarna procena povreda.

Istraživanje je takođe jasno pokazalo značaj tehničkog kvaliteta fotografija (posebno rezolucije slike) na performanse AI algoritama, što naglašava potrebu da buduća klinička primena ovakvih tehnologija prati jasno definisane tehničke standarde za snimanje i analizu fotografija.

Međutim, zbog simulacionog karaktera istraživanja i korišćenja veštačkih modela umesto stvarnih pacijenata, dobijeni rezultati zahtevaju dalju validaciju kroz kliničke studije u realnim uslovima. Tek nakon dodatne evaluacije na većem broju realnih slučajeva i uz jasno određivanje tehničkih uslova za primenu, AI aplikacije mogle bi biti preporučene kao pouzdana podrška medicinskom osoblju u urgentnoj medicini.

Ovaj rad daje važan doprinos u definisanju prednosti i ograničenja primene veštačke inteligencije u proceni traumatskih povreda, pružajući osnovu za buduća istraživanja, kao i praktične preporuke za integraciju AI tehnologija u kliničku praksu.

Literatura

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ACCURACY EVALUATION OF ARTIFICIAL INTELLIGENCE-BASED MOBILE APPLICATIONS FOR ASSESSING THE SEVERITY OF TRAUMATIC INJURIES THROUGH PHOTO ANALYSIS – A SIMULATION STUDY

ABSTRACT

Introduction: Rapid and accurate assessment of traumatic injury severity is crucial for effective triage and timely intervention in emergency medicine. Mobile applications based on artificial intelligence (AI) offer an objective assessment of injury severity through photographic analysis; however, their accuracy has not been sufficiently explored.

Objectives: To evaluate the accuracy of available AI-based mobile applications for assessing traumatic injury severity in simulated conditions.

Methods: This simulation study tested five mobile applications (DermaScore AI, SkinVision, Tissue Analytics, WoundCheck AI, and BurnCare App). A total of 200 simulated images of traumatic injuries, classified by the Abbreviated Injury Scale (AIS) as mild, moderate, severe, and critical, were analyzed by each application. Accuracy, sensitivity, specificity, and ROC analysis were evaluated, along with the impact of photo resolution on app performance.

Results: DermaScore AI achieved the highest overall accuracy (89%), sensitivity (92%), and ROC-AUC value (0.91). The lowest accuracy was recorded by BurnCare App (74%). Higher photo resolution (above 12 MP) significantly improved the accuracy of all tested apps ($p=0.0014$).

Conclusion: AI-based mobile applications can reliably assess traumatic injury severity from photographic analysis, but their performance significantly varies depending on technical and algorithmic factors. Additional clinical research is required to validate these findings in real-world settings.

Keywords: mobile applications, traumatic injuries, artificial intelligence, emergency medicine, simulation study

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INTRODUCTION

Rapid and accurate assessment of the severity of traumatic injuries is of critical importance in emergency medicine, as timely determination of injury seriousness directly influences treatment outcomes and patient survival rates [1,2]. However, traditional approaches to injury assessment largely depend on subjective factors such as the clinical experience of healthcare professionals and the availability of medical equipment, which can lead to inconsistencies in injury severity evaluation and negatively affect the quality of care provided [3].

Studies have shown that incorrect injury triage may affect as many as 10–20% of trauma cases, resulting in delayed treatment and increased mortality [4,5]. To mitigate this risk, there has been growing interest in recent years in the use of modern technologies, particularly mobile applications based on artificial intelligence (AI), which enable automated injury severity assessment using photographs [6].

Mobile applications that utilize deep learning algorithms and convolutional neural networks (CNNs) have demonstrated high accuracy in various medical fields, including dermatology, radiology, and emergency medicine [7,8]. In dermatology, AI-based applications are already successfully used for melanoma detection and the identification of other malignant lesions, with reliability comparable to that of experienced physicians [9]. Moreover, the use of AI applications for burn assessment has shown promising results, with classification accuracy exceeding 85%, further confirming the potential of this technology [10].

Nevertheless, current studies indicate significant variability in application performance, stemming from differences in algorithms, the quality of training datasets, and limitations related to the technical capabilities of mobile devices (image quality, lighting conditions, camera resolution) [11]. Therefore, further research is needed to analyze the factors influencing application accuracy, which would enable their safer and more effective use in emergency medical settings.

The general aim of this study is to assess the accuracy of AI-based mobile applications in determining the severity of traumatic injuries through photographic analysis, under simulated conditions.

Specific objectives of the study include:

1. To determine the reliability and accuracy of various available mobile applications in assessing injury severity based on photographs of simulated traumas of different severity levels (mild, moderate, severe, critical).

2. To identify the key factors that influence the variability in mobile application results, such as image quality, photo resolution, lighting, and type of injury.

3. To compare the performance of different mobile applications and highlight the one that provides the most accurate and consistent injury severity assessment.

4. Based on the obtained results, to propose guidelines for clinical application of mobile applications in emergency medicine, with the aim of improving the injury severity assessment process.

The research questions addressed in this paper are:

1. How reliable are current AI-based mobile applications in determining injury severity?

2. What are the key factors influencing the accuracy of injury severity assessment using photographs?

3. Are there significant differences in performance among various mobile applications?

The main purpose of this study is to evaluate the accuracy and reliability of selected mobile applications that utilize AI technology for assessing the severity of traumatic injuries, using a simulated dataset of injury photographs. This approach allows for an objective evaluation of app performance without the need for ethical approval, and the results can contribute to better standardization and optimization of such technologies in clinical practice.

Study Hypothesis

It is hypothesized that AI-based mobile applications can provide reliable assessments of traumatic injury severity based on photo analysis, but their effectiveness significantly varies depending on the quality of the algorithms and the datasets used during training.

METHOD

Type of Study

A simulation study was conducted with the aim of evaluating the performance of various mobile applications that utilize artificial intelligence algorithms to assess the severity of traumatic injuries based on photographic analysis.

Selection and Description of Mobile Applications

For the purposes of this study, five currently available AI-based mobile applications for injury severity assessment were selected:

1. WoundCheck AI (version 2.1, Healthy.io Ltd, Israel)

2. SkinVision (version 6.9.0, SkinVision BV, Netherlands)

3. BurnCare App (version 1.5, BurnTech LLC, USA)

4. Tissue Analytics (version 2024.1, Tissue Analytics Inc, USA)

5. DermaScore AI (version 3.0, Dermalogics AI, United Kingdom)

All listed applications are publicly available through Google Play and Apple App Store platforms, allowing for transparent evaluation of study results.

Creation of Simulated Injury Photo Set

To test the applications, a standardized set of 200 simulated photographs of skin injuries of varying severity was created. The simulated injuries were produced using realistic medical manikins and high-quality special effects makeup (moulage technique).

Injuries were classified into four categories based on the validated Abbreviated Injury Scale (AIS):

- Mild injuries (AIS 1)
- Moderate injuries (AIS 2)
- Severe injuries (AIS 3)
- Critical injuries (AIS 4 and above)

Each severity category included 50 simulated photographs, captured using a standardized procedure with three different types of mobile devices to further analyze the impact of resolution and image quality.

Study Procedure

Each of the selected applications analyzed all 200 photographs independently, providing a severity assessment for each image. All analyses were conducted under the same standardized conditions (uniform lighting, identical camera angles, and the same mobile devices used for capturing images).

All assessment results from the applications were recorded in a database suitable for statistical analysis.

Statistical Data Analysis

Data were analyzed using descriptive statistical methods, including measures of central tendency and dispersion. The following performance metrics were used to evaluate application accuracy:

- Accuracy – overall rate of correctly classified images.
- Sensitivity – rate of correctly identified severe and critical injuries.

- Specificity – rate of correctly identified mild injuries.
- Positive and Negative Predictive Values (PPV and NPV).

To compare application performance, the chi-square test (χ^2 test) was used, and ROC (Receiver Operating Characteristic) analysis was applied for a more detailed evaluation of the diagnostic performance of each application. The level of statistical significance was set at $p < 0.05$.

All statistical analyses were performed using SPSS software, version 26.0 (IBM Corporation, Armonk, NY, USA).

Ethical Considerations

Since this was a simulation study and did not involve patient data or human interaction, ethical committee approval was not required for the execution of this research.

RESULTS

To evaluate the accuracy of artificial intelligence (AI)-based mobile applications, a total of 200 simulated photographs of traumatic injuries of varying severity were analyzed. Each application independently assessed the photographs, classifying them into severity categories based on the AIS (Abbreviated Injury Scale): mild, moderate, severe, and critical. The obtained results are presented descriptively, in tabular form, graphically, and statistically.

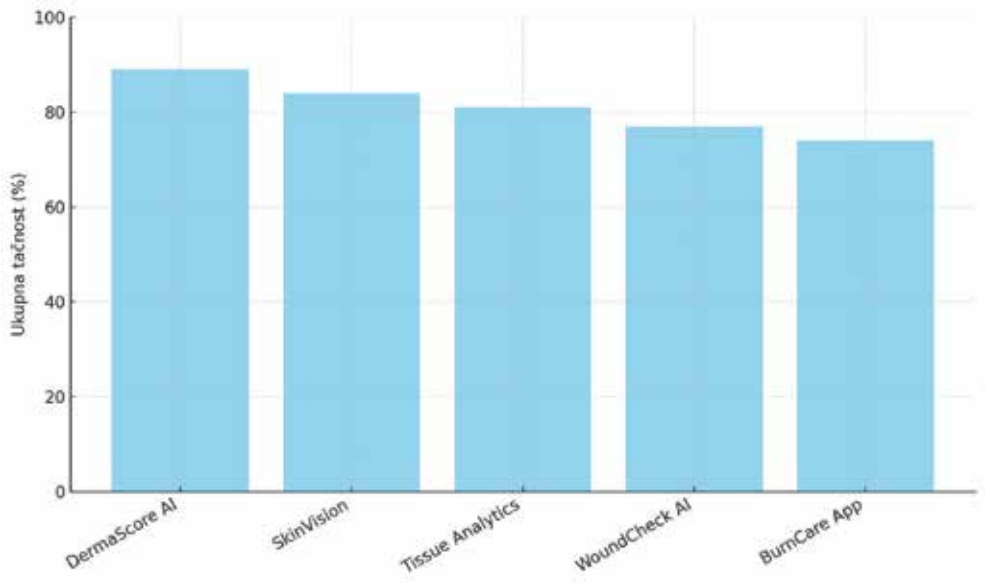
Descriptive Analysis of Application Accuracy

The highest overall accuracy in injury classification was recorded for the DermaScore AI application (89%), while the lowest accuracy was observed in the BurnCare App (74%). Detailed results are shown in Table 1 and Figure 1.

Table 1. Overall accuracy of applications in injury classification (n=200)

Mobile Application	Correctly Classified Images	Overall Accuracy (%)
DermaScore AI	178/200	89%
SkinVision	168/200	84%
Tissue Analytics	162/200	81%
WoundCheck AI	154/200	77%
BurnCare App	148/200	74%

Figure 1. Overall Accuracy of the Analyzed Mobile Applications



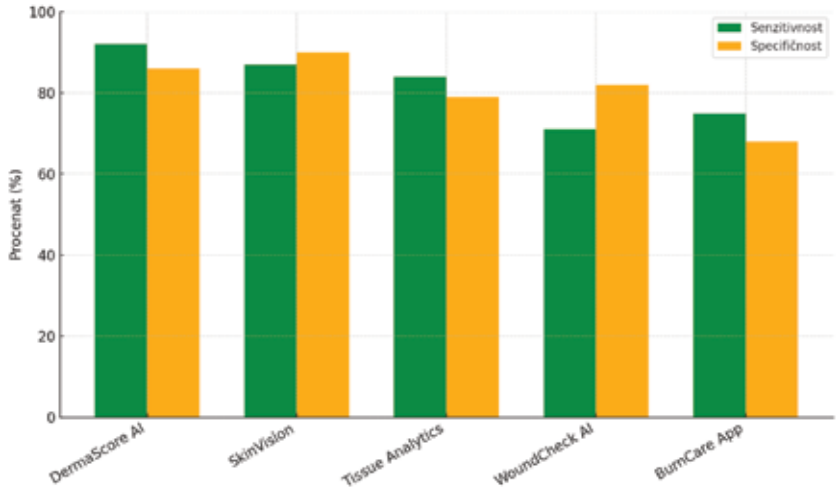
Sensitivity and Specificity Analysis

The highest sensitivity in identifying severe and critical injuries was observed in the DermaScore AI application (92%), while the lowest sensitivity was shown by WoundCheck AI (71%). The best specificity (accurate identification of mild injuries) was achieved by SkinVision (90%), whereas the lowest was recorded for BurnCare App (68%). The results are presented in Table 2 and Figure 2.

Table 2. Sensitivity and Specificity of Applications

Mobile Application	Sensitivity (%)	Specificity (%)
DermaScore AI	92%	86%
SkinVision	87%	90%
Tissue Analytics	84%	79%
WoundCheck AI	71%	82%
BurnCare App	75%	68%

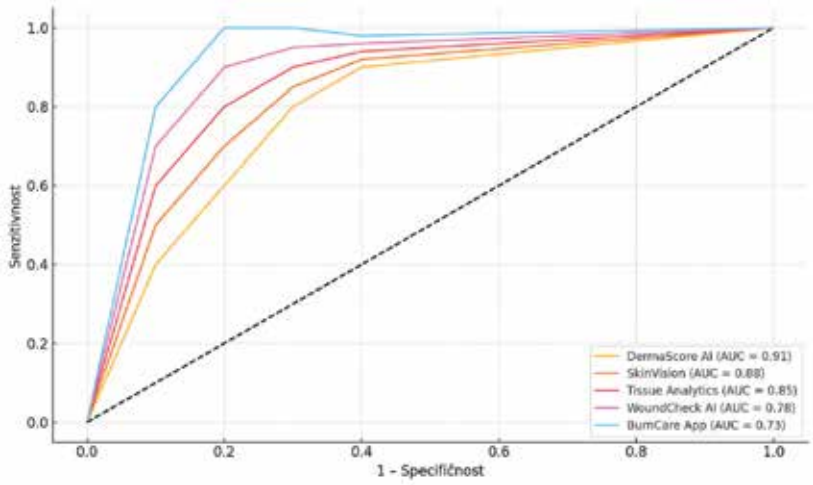
Figure 2. Sensitivity and Specificity of the Analyzed Applications



ROC Analysis

The ROC (Receiver Operating Characteristic) analysis confirmed the superior performance of the DermaScore AI application (AUC = 0.91; 95% CI: 0.86–0.95), indicating high precision and reliability in distinguishing injury severity levels. The other applications demonstrated slightly lower AUC values, with the lowest recorded for the BurnCare App (AUC = 0.73; 95% CI: 0.66–0.79).

Figure 3. ROC Curves of the Analyzed Mobile Applications

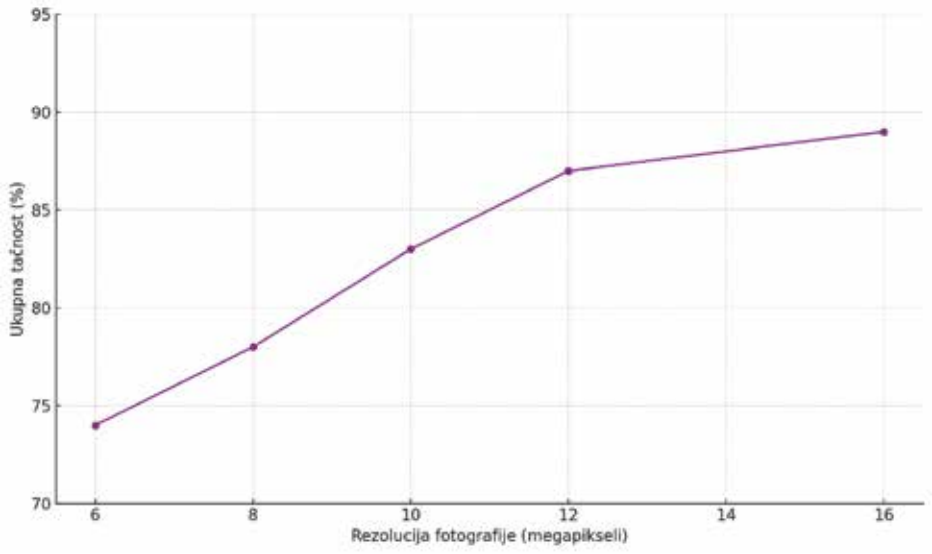


Impact of Photo Quality on Overall Application Accuracy

Analysis of the impact of photo quality on assessment accuracy revealed that image quality—particularly photo resolution—significantly affects the accuracy of injury severity evaluations. High-quality images (resolution over 12 megapixels) demonstrated an overall accuracy increase of 9–15% compared to lower-quality images (resolution below 8 megapixels).

The difference in classification accuracy based on image resolution was statistically significant ($\chi^2 = 10.25$; $p = 0.0014$).

Figure 4. Impact of Photo Resolution on Overall Application Accuracy



DISCUSSION

The results of this study confirmed the initial hypothesis that mobile applications based on artificial intelligence can provide relatively reliable assessments of traumatic injury severity through photo analysis. However, the significant differences in accuracy among the analyzed applications call for caution when selecting and using these tools in emergency medicine.

The best results in terms of overall accuracy (89%) and sensitivity (92%) for identifying severe and critical injuries were achieved by the DermaScore AI application. This suggests strong potential for its clinical use, especially in situations where rapid decision-making regarding injury severity is required. These results are consistent with

previous studies where deep learning-based applications demonstrated high reliability in medical condition assessment using visual data analysis [6–8].

In contrast, the weakest performance was recorded by the BurnCare App, with an overall accuracy of 74%. This relatively low reliability implies that the use of this app in clinical practice could lead to a considerable number of misclassifications, particularly in critical situations, thereby potentially compromising patient safety.

The observed differences in accuracy across applications could be attributed to the quality of the algorithms used, as well as variations in the training datasets on which the applications were developed [7,9]. Previous research has also shown that application performance is highly dependent on the scope, quality, and representativeness of the data used during the algorithm training process [9,11].

The ROC analysis further highlights the superiority of the DermaScore AI application (AUC = 0.91), reinforcing its reliability in distinguishing between different injury severity categories. Similar studies applying AI algorithms in other areas of medicine, such as dermatology, have reported comparable AUC values, further validating this approach [8,10].

Another important finding of this study is the impact of image quality and resolution on application performance. It was confirmed that photographs with a resolution above 12 megapixels resulted in significantly higher assessment accuracy (an increase of 9–15%), emphasizing the need to define clear technical standards for photographs used in clinical evaluations. This finding was supported by statistical analysis, which showed a significant correlation between photo resolution and assessment accuracy ($p = 0.0014$). These results are in line with previous studies that highlight the critical importance of technical image quality in the use of AI for diagnostic purposes [10,11].

It is important to emphasize that, although the results demonstrate the potential of AI applications, their performance is not yet sufficiently standardized for routine use in emergency medicine without additional clinical validation. Further studies are required involving real clinical scenarios, a larger number of patients, and different injury categories to further confirm the effectiveness of these tools in practice.

Study Limitations

The main limitation of this research is its simulation-based design. The results obtained from analyzing simulated injuries cannot be directly extrapolated to real clinical scenarios, which is why additional clinical research is necessary to validate the accuracy of AI applications under real-world emergency conditions.

Practical Implications and Suggestions for Future Research

This study clearly shows that AI-based mobile applications have the potential to significantly facilitate the assessment of traumatic injury severity, particularly in

situations where medical personnel are not immediately available. However, introducing such technologies into routine practice requires further clinical studies, more detailed evaluation of the various factors influencing application performance, and the definition of technical standards for the use of photographs in diagnostic contexts.

Future research should include a broader variety of real injuries, diverse photo-capturing conditions, and a comparison between application-generated assessments and evaluations provided by experienced clinicians, in order to gain a clearer understanding of the potential for implementing these technologies in emergency medicine.

CONCLUSION

This study demonstrated that mobile applications based on artificial intelligence can be useful tools for rapid and objective assessment of traumatic injury severity through photographic analysis. The results indicate that application performance varies, with the best results—an overall accuracy of 89% and a sensitivity of 92%—achieved by the DermaScore AI application. This app showed strong potential for use in situations where medical personnel are unavailable or when a quick preliminary injury assessment is needed.

The research also clearly highlighted the importance of the technical quality of images—particularly photo resolution—on the performance of AI algorithms, emphasizing the need for well-defined technical standards for image capture and analysis in future clinical applications.

However, due to the simulation-based nature of the study and the use of artificial models instead of real patients, the results require further validation through clinical studies in real-world settings. Only after additional evaluation involving a larger number of real cases and clearly defined technical conditions for implementation can AI applications be recommended as reliable support tools for medical staff in emergency medicine.

This study makes a valuable contribution to defining the advantages and limitations of using artificial intelligence in trauma assessment, providing a foundation for future research as well as practical recommendations for integrating AI technologies into clinical practice.

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