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Grant Proposal

Using Image-based AI for insect monitoring and conservation - InsectAI COST Action

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Abstract

The InsectAI COST action will support insect monitoring and conservation at the national and continental scale in order to understand and counteract widespread insect declines. The Action will bring together a critical mass of researchers and stakeholders in image-based insect AI technologies to direct and drive the research agenda, build research capacity across Europe and support innovation and application.

There is mounting evidence that populations of insects around the world are in sharp decline. Understanding trends in species and their drivers is key to knowing the size of the challenge, its causes and how to address it. To identify solutions that lead to sustainable biodiversity alongside economic prosperity, insect monitoring should be efficient and provide standardised and frequently updated status indicators to guide conservation actions.

The EU Biodiversity Strategy 2030 identifies the critical challenge of delivering standardised information about the state of nature and image-based insect AI can contribute to this. Specifically, the EU Nature Restoration Law will likely set binding targets for the high resolution data that cameras can provide. Thus, outputs of the Action will contribute directly to EU policies implementation, where biodiversity monitoring is considered a key component.

The InsectAI COST Action will organise workshops, conferences, short-term scientific missions, hackathons, design-sprints and much more, across four Working Groups. These groups will address how image-based insect AI technologies can best address

Societal Needs, support innovation in Image Collection hardware, create standardised approaches for Image Processing and develop novel Data Analysis and Integration methods for turning data into actionable insights.

Keywords

camera, computer vision, statistics, autonomous, standards, insects, monitoring, collaboration, inclusive, COST

Translations of the abstract

Albanian

Veprimi i COST InsectAI ka si qëllim të mbështesë monitorimin dhe ruajtjen e insekteve në rang kombëtare dhe botëror, për të kuptuar fillimisht, dhe pastaj për të kundërshtuar rënien e vërejtur të insekteve. Ky veprim do të bashkojë një numër të madh kërkuesish dhe grupeve të interesuar në përdrorimin e teknologjive-AI duke përdorur imazhet e insekteve, për të orientuar dhe shtyrë përpara axhendën e kërkimit, për të ndërtuar kapacitetet kërkimore në gjithë Evropën dhe për të mbështetur inovacionin dhe aplikimin.

Ka prova në rritje që popullatat e insekteve në mbarë botën janë në rënie drastike. Kuptimi i trendit të llojeve dhe drejtimit të tyre, është çelësi për të ditur madhësinë e sfidës, shkaqet e saj dhe mënyrën se si të trajtohet ajo. Për të identifikuar zgjidhje që mundësojnë një zhvillim të qëndrueshëm midis biodiversitetit dhe zhvillimit ekonomik, monitorimi i insekteve duhet të jetë efikas dhe të ofrojë tregues të statusit të tyre të të përditësuar, për të orientuar veprimet e ruajtjes së tyre.

Strategjia e BE-së për Biodiversitetin 2030 identifikon si sfidë kryesore ofrimin e informacionit të standardizuar për gjendjen e natyrës dhe AI për insektet, duke në bazë të saj, imazhet që mund të kontribuojë në këtë drejtim. Në veçanti, Ligji i BE-së: "Për Rigjenerimin e Natyrës" ka të ngjarë të vendosë kritere detyruese për të pasur aparate fotografike me rezulucion të lartë për tu përdorur. Kështu, rezultatet e këtij Veprimi, do të kontribuojnë drejtpërdrejt në zbatimin e politikave të BE-së, ku monitorimi i biodiversitetit konsiderohet një komponent kyç i saj.

Veprimi i COST InsectAI do të organizojë në të katër Grupët e Punës: seminare, konferenca, sesione shkencore afatshkurtra, takime për softuerë, seminare intensive, etj. Këto grupe do të trajtojnë mënyrën se si teknologjitë AI të bazuara në imazhet e insekteve mund të adresojnë më së miri nevojat e shoqërisë, të mbështesin inovacionin në pajisjet e mbledhjes së imazheve, të krijojnë qasje të standardizuara për përpunimin e imazheve dhe të zhvillojnë metoda të reja për analizën dhe integrimin e të dhënave me qëllim për ti kthyer këto të dhëna në njohuri të zbatueshme.

Bulgarian

Има нарастващи доказателства, че популациите на насекомите по света са в рязък спад. Разбирането на тенденциите при видовете и техните двигатели е от ключово значение за познаването на размера на предизвикателството, причините за него и как да се справим с него. За да се установят решения, които водят до устойчиво биоразнообразие заедно с икономическия просперитет, мониторингът на насекомите трябва да бъде ефективен и да предоставя стандартизирани и често актуализирани индикатори за състоянието, които да насочват действията за опазване.

Стратегията на ЕС за биологичното разнообразие до 2030 г. идентифицира критичното предизвикателство за предоставяне на стандартизирана информация за състоянието на природата и базираният на изображения Insect AI може да допринесе за това. По-конкретно, Законът за възстановяване на природата на ЕС вероятно ще постави задължителни цели за данните с висока разделителна способност, които камерите могат да предоставят. По този начин резултатите от Акцията ще допринесат пряко за прилагането на политиките на ЕС, където мониторингът на биоразнообразието се счита за ключов компонент.

InsectAI COST акцията ще организира семинари, конференции, краткосрочни научни мисии, хакатони, дизайнерски състезания и много други в четири работни групи. Тези групи ще се занимават с това как базираните на изображения Insect AI технологи могат най-добре да отговорят на обществените нужди, да подкрепят иновациите в хардуера за събиране на изображения, да създадат стандартизирани подходи за обработка на изображения и да разработят нови методи за анализ на данни и интегриране за превръщане на данните в действителни познания

Catalan

L'acció InsectAI COST donarà suport al seguiment i conservació d'insectes a escala nacional i continental per entendre i contrarestar el declivi generalitzat d'insectes. L'acció reunirà una massa crítica d'investigadors i parts interessades en tecnologies d'IA d'insectes basades en imatges per dirigir i impulsar l'agenda de recerca, construir capacitats de recerca a tot Europa i donar suport a la innovació i l'aplicació.

Cada cop hi ha més proves que les poblacions d'insectes a tot el món estan sofrint un fort declivi. Entendre les tendències de les espècies i els factors que les determinen és clau per conèixer la mida del repte, les seves causes i com afrontar-lo. El seguiment d'insectes ha de ser eficient i proporcionar indicadors d'estat estandarditzats i actualitzats freqüentment per guiar les accions de conservació i per identificar solucions que condueixin a una biodiversitat sostenible juntament amb la prosperitat econòmica..

L'Estratègia de biodiversitat de la UE 2030 identifica el repte crític de proporcionar informació estandarditzada sobre l'estat de la natura, i la IA d'insectes basada en imatges hi pot contribuir. Concretament, la Llei de restauració de la natura de la UE probablement establirà objectius vinculants per a les dades d'alta resolució que poden

proporcionar les càmeres. Així, els resultats de l'acció contribuiran directament a la implementació de les polítiques de la UE, on el seguiment de la biodiversitat es considera un component clau.

L'acció InsectAI COST organitzarà tallers, conferències, missions científiques a curt termini, hackatons, sprints de disseny i molt més, a través de quatre grups de treball. Aquests grups abordaran com les tecnologies d'IA d'insectes basades en imatges poden abordar millor les necessitats socials, donar suport a la innovació en el maquinari de recollida d'imatges, crear enfocaments estandarditzats per al processament d'imatges i desenvolupar nous mètodes d'anàlisi i integració de dades per convertir les dades en coneixements útils.

Croatian

COST akcija InsectAI ima za cilj podržati praćenje i očuvanje kukaca na nacionalnoj i kontinentalnoj razini, čime se teži boljem poznavanju kukaca i sprječavanju njihovog sve većeg smanjenja brojnosti. Akcija će okupiti vodeće istraživače i ključne dionike u primjeni tehnologija zasnovanih na analizi slika i umjetnoj inteligenciji (AI). Cilj je usmjeriti i potaknuti istraživanja, izgraditi istraživačke kapacitete diljem Europe, te podržati inovacije i upotrebu suvremenih tehnologija.

Sve više dokaza ukazuje na drastičan pad populacija kukaca diljem svijeta. Razumijevanje trendova u brojnosti vrsta i uočavanje promjena ključno je za procjenu veličine izazova, njegovih uzroka i mogućih rješenja. Učinkovito praćenje kukaca, koje koristi standardizirane i redovito ažurirane pokazatelje stanja, neophodno je za usmjeravanje aktivnosti zaštite te postizanje održive bioraznolikosti u skladu s gospodarskim napretkom.

EU Strategija o biološkoj raznolikosti za 2030. godinu ističe važnost dostave standardiziranih informacija o stanju prirode. Primjena AI, trenirane na slikama kukaca, može značajno pridonijeti ovom cilju. Nadalje, predloženi Zakon o obnovi prirode EU-a vjerojatno će postaviti obvezujuće ciljeve za prikupljanje podataka visoke razlučivosti putem kamera, što će dodatno potvrditi važnost rezultata ove Akcije za provedbu politika EU-a, u kojima se praćenje bioraznolikosti smatra ključnim elementom.

InsectAI COST akcija organizirat će radionice, konferencije, kratkoročne znanstvene misije, hackathone, "design sprintove" i mnoge druge aktivnosti unutar četiri radne skupine. Radne skupine će razmatrati najbolje prakse za korištenje tehnologija analize slika i AI, kako bi se odgovorilo na društvene potrebe, potaknule inovacije u tehnologiji prikupljanja slika, stvorile standardizirane metode i pristupe za obradu slika, te razvile nove metode analize i integracije podataka u korisne uvide.

Czech

COST akce InsectAI bude podporovat monitoring a ochranu hmyzu na národní a kontinentální úrovni, aby bylo možné pochopit a čelit rozsáhlému úbytku hmyzu. Tato akce spojí potřebnou masu výzkumníků a zainteresovaných stran v oblasti technologií

umělé inteligence pro rozpoznávání hmyzu na základě obrazu. To umožní lepší řízení a usměrnění výzkumné agendy, budování výzkumných kapacit po celé Evropě a podporu inovací a aplikací.

Existují stále přesvědčivější důkazy o tom, že populace hmyzu po celém světě prudce klesají. Pochopení trendů u jednotlivých druhů a jejich příčin je klíčové pro zjištění rozsahu problému, jeho příčin a způsobů, jak jej řešit. Aby bylo možné nalézt řešení, která povedou k udržitelné biologické rozmanitosti a zároveň k hospodářské prosperitě, měl by být monitoring hmyzu účinný a poskytovat standardizované a často aktualizované ukazatele stavu, podle kterých by se řídila opatření pro ochranu přírody.

Strategie EU v oblasti biologické rozmanitosti do roku 2030 označuje za zásadní úkol poskytovat standardizované informace o stavu přírody, k čemuž může přispět umělá inteligence založená na snímcích hmyzu. Konkrétně, zákon EU o obnově přírody pravděpodobně stanoví závazné cíle pro vysoce kvalitní data, která mohou poskytovat fotoaparáty/kamery. Výstupy akce tak přímo přispějí k provádění politik EU, kde je monitorování biologické rozmanitosti považováno za klíčovou součást.

COST akce InsectAI bude organizovat workshopy, konference, krátkodobé vědecké mise, hackathony, designové sprinty a mnoho dalšího, a to ve čtyřech pracovních skupinách. Tyto skupiny se budou zabývat tím, jak mohou technologie umělé inteligence pro rozpoznávání hmyzu na základě obrazu vhodně řešit společenské potřeby, podporovat inovace hardwaru pro sběr obrazu, vytvářet standardizované přístupy k zpracování obrazu a vyvíjet nové metody analýzy a integrace dat, které umožní přeměnu dat na užitečné poznatky.

Danish

COST-aktionen InsectAI vil bidrage til overvågning og bevarelse af insekter på nationalt og internationalt plan med det formål at forstå og modvirke den igangværende tilbagegang af insekter. Aktionen vil samle en kritisk masse af forskere og interessenter inden for billedbaserede KI-teknologier til insekter for at styre og drive forskningsdagsordenen fremad, opbygge forskningskapacitet i hele Europa og støtte innovation og anvendelse.

Der er stigende evidens for, at insektbestande rundt om i verden er i kraftig tilbagegang. At kende udviklingen for arter og de underliggende drivkræfter er nøglen til at forstå omfanget af dette problem, dets årsager, og hvordan det kan løses. At finde løsninger, der gavner både biodiversitet og økonomisk velstand, kræver effektiv insektovervågning med standardiserede og hyppigt opdaterede statusindikatorer, der kan informere om bevaringstiltag.

EU's biodiversitetsstrategi for 2030 identificerer den kritiske udfordring ved at levere standardiseret information om naturens tilstand. Billedbaseret KI-teknologi kan bidrage til dette. Mere specifikt vil EU's naturgenopretningslov sandsynligvis sætte bindende mål for den type data af høj opløsning, som kameraer kan levere. Med andre ord vil resultaterne

af denne aktion bidrage direkte til gennemførelsen af EU's politikker, hvor overvågning af biodiversitet betragtes som en nøglekomponent.

COST-aktionen InsectAI vil organisere workshops, konferencer, kortvarige forskerudvekslingsophold, hackathons, design sprints og meget mere på tværs af fire arbejdsgrupper. Disse grupper vil arbejde på, hvordan insektfokuseret billedbaseret KI-teknologi bedst kan opfylde samfundets behov, støtte innovation inden for billedindsamlingshardware, skabe standardiserede metoder til billedbehandling og udvikle nye dataanalyse- og integrationsmetoder der omdanner data til handlingsorienteret indsigt.

Dutch

De InsectAI COST actie zal insecten monitoring en -behoud op nationale en continentale schaal ondersteunen om de wijdverspreide achteruitgang van insecten te begrijpen en tegen te gaan. De COST actie zal een kritieke massa van onderzoekers en belanghebbenden samenbrengen op het gebied van AI technologieën voor foto's van insecten om zo de onderzoeksagenda te sturen, de onderzoekscapaciteit in Europa op te bouwen en innovatie en toepassing te ondersteunen.

Er is steeds meer bewijs dat insectenpopulaties over de hele wereld sterk afnemen. Het begrijpen van trends in soorten en hun drijfveren is essentieel om de omvang van de uitdaging, de oorzaken en de aanpak ervan beter te kunnen adresseren. Om oplossingen te identificeren die leiden tot duurzame biodiversiteit naast economische welvaart, moet insecten monitoring efficiënt zijn en gestandaardiseerde en regelmatig bijgewerkte statusindicatoren bieden om beschermingsacties te begeleiden.

De EU-biodiversiteitsstrategie voor 2030 identificeert de kritieke uitdaging om gestandaardiseerde informatie over de toestand van de natuur te leveren, en op beeld gebaseerde AI technologieën voor insecten kunnen hieraan bijdragen. Specifiek zal de EU Natuurherstelwet waarschijnlijk bindende doelen stellen voor de hoge resolutie gegevens die camera's kunnen leveren. De resultaten van de COST actie zullen dus rechtstreeks bijdragen aan de implementatie van EU beleid, waarbij biodiversiteitsmonitoring wordt beschouwd als een belangrijk onderdeel.

De InsectAI COST actie zal workshops, conferenties, korte wetenschappelijke missies, hackathons, ontwerpsessies en nog veel meer organiseren, verspreid over vier werkgroepen. Deze groepen zullen zich bezighouden met hoe op beeld gebaseerde AI-technologieën voor insecten het beste kunnen inspelen op maatschappelijke behoeften, innovatie in beeldverzamelinghardware kunnen ondersteunen, gestandaardiseerde benaderingen voor beeldverwerking kunnen creëren en nieuwe data-analyse- en integratiemethoden kunnen ontwikkelen om data om te zetten in bruikbare inzichten.

Estonian

InsectAI COST Action toetab putukate seiret ja kaitset riiklikul ja mandri tasandil, et mõista putukate laialdast vähenemist ja selle vastu võidelda. Meede koondab kriitilise massi

teadlasi ja huvirühmi putukate pildipõhistes tehisintellekti tehnoloogiates, et suunata ja juhtida teadusuuringute tegevuskava, suurendada uurimissuutlikkust kogu Euroopas ning toetada innovatsiooni ja rakendusi.

Järjest rohkem on tõendeid selle kohta, et putukate populatsioonid kogu maailmas on järsult vähenemas. Liikide ja nende mõjutajate suundumuste mõistmine on võtmetähtsusega väljakutse suuruse, põhjuste ja sellega tegelemise juures. Et leida lahendusi, mis viivad jätkusuutliku bioloogilise mitmekesisuseni koos majandusliku õitsenguga, peaks putukate seire olema tõhus ning pakkuma kaitsemeetmete suunamiseks standardiseeritud ja sageli ajakohastatud seisundinäitajaid.

ELi bioloogilise mitmekesisuse strateegias aastani 2030 määratletakse loodusseisundi kohta standardiseeritud teabe edastamist kui kriitilise tähtsusega väljakutset ning pildipõhine putukate tehisintellekt võib sellele kaasa aidata. Täpsemalt, ELi looduse taastamise seadus seab tõenäoliselt siduvad eesmärgid kõrge eraldusvõimega andmetele, mida kaamerad võivad pakkuda. Seega aitavad meetme väljundid otseselt kaasa ELi poliitika elluviimisele, kus bioloogilise mitmekesisuse seiret peetakse võtmekomponendiks.

InsectAI COST Action korraldab neljas töörühmas töötubasid, konverentse, lühiajalisi teadus lähetusi, häkatone, disainisprinte ja palju muud. Need rühmad käsitlevad seda, kuidas pildipõhised putukate tehisintellekti tehnoloogiad saavad kõige paremini rahuldada ühiskondlikke vajadusi, toetada innovatsiooni pildikogumise riistvaras, luua standardiseeritud lähenemisviise pilditöötluseks ning töötada välja uudsed andmeanalüüsi ja integreerimise meetodid andmete muutmiseks kasutatavateks teadmisteks.

French

L'action COST InsectAI contribue à la surveillance et à la conservation des insectes à l'échelle nationale et continentale afin de comprendre et de contrer le déclin généralisé des insectes. L'action rassemble une masse critique de chercheurs et de parties prenantes dans le domaine des technologies de l'intelligence artificielle et de l'imagerie d'insectes afin d'orienter et de conduire le programme de recherche, de renforcer les capacités de recherche à travers l'Europe et de soutenir l'innovation et les applications potentielles.

Il est de plus en plus évident que les populations d'insectes du monde entier sont en forte diminution. Il est donc essentiel de comprendre les tendances des espèces et les facteurs de déclin pour connaître l'ampleur du défi, ses causes et la manière de le relever. Pour trouver des solutions permettant de concilier biodiversité durable et prospérité économique, la surveillance des insectes doit être efficace et fournir des indicateurs d'état normalisés et fréquemment mis à jour afin d'orienter les mesures de conservation.

La stratégie de l'UE en faveur de la biodiversité à l'horizon 2030 a mis l'accent sur le défi majeur que représente la fourniture d'informations normalisées sur l'état de la nature, et

l'IA des insectes basée sur l'imagerie peut y contribuer. En particulier, la loi européenne sur la restauration de la nature fixera probablement des objectifs impératifs pour les données à haute résolution que les appareils photographiques peuvent fournir. Les résultats de cette action contribueront donc directement à la mise en œuvre des politiques de l'UE, dont le suivi de la biodiversité est considéré comme un élément-clé.

L'action COST InsectAI organisera des ateliers, des conférences, des missions scientifiques à court terme, des marathons de programmation, des design-sprints et bien plus encore, au sein de quatre groupes de travail. Ces groupes se pencheront sur la manière dont les technologies d'IA basées sur l'analyse d'imagerie peuvent répondre au mieux aux besoins sociétaux, soutiendront l'innovation en matière de matériel de collecte de photographies, créeront des approches normalisées pour le traitement des images et développeront de nouvelles méthodes d'analyse et d'intégration des données afin de transformer les données en informations exploitables.

German

Die COST-Action InsectAI wird das Insektenmonitoring und den Insektenschutz auf nationaler und kontinentaler Ebene unterstützen, um den weit verbreiteten Insektenrückgang zu verstehen und ihm entgegenzuwirken. Sie wird eine kritische Masse an Forschern und Interessenvertretern im Bereich bildbasierter KI-Technologien für Insektenbeobachtungen zusammenbringen, um die Forschungsagenda zu leiten und voranzutreiben, Forschungskapazitäten in ganz Europa aufzubauen sowie Innovationen und Anwendungen zu unterstützen.

Es gibt immer mehr Hinweise darauf, dass die Insektenpopulationen weltweit stark zurückgehen. Kenntnisse von Artentrends und ihren Treibern ist der Schlüssel zum Verständnis des Ausmaßes dieser Herausforderung, ihrer Ursachen und der Art und Weise, wie sie angegangen werden kann. Um Lösungen zu finden, die neben wirtschaftlichem Wohlstand zu nachhaltiger Artenvielfalt führen, sollte das Insektenmonitoring effizient sein und standardisierte, häufig aktualisierte Statusindikatoren liefern, um Schutzmaßnahmen zu leiten.

Die EU-Biodiversitätsstrategie 2030 identifiziert die entscheidende Herausforderung, standardisierte Informationen über den Zustand der Natur zu liefern, und bildbasierte KI-Verfahren für Insektenbeobachtungen können dazu beitragen. Insbesondere wird das EU-Gesetz zur Wiederherstellung der Natur wahrscheinlich verbindliche Ziele für die hochauflösenden Daten festlegen, die Kameras liefern können. Daher werden die Ergebnisse dieser COST-Action direkt zur Umsetzung der EU-Politik beitragen, bei der die Überwachung der Artenvielfalt als Schlüsselkomponente angesehen wird.

Die COST-Action InsectAI organisiert Workshops, Konferenzen, wissenschaftliche Kurzprojekte über sogenannte short-term scientific missions, Hackathons, Design-Sprints und vieles mehr in vier Arbeitsgruppen. Diese Gruppen werden sich damit befassen, wie bildbasierte KI-Technologien zur Insektenbeobachtung gesellschaftliche Bedürfnisse am besten erfüllen, Innovationen bei der Hardware zur Bildaufnahme unterstützen,

standardisierte Ansätze für die Bildverarbeitung schaffen und neuartige Datenanalyse- und -integrationsmethoden entwickeln, um Daten in verwertbare Erkenntnisse für umsetzbare Maßnahmen umzuwandeln.

Greek

Η δράση COST "InsectAI" υποστηρίζει την παρακολούθηση και τη διατήρηση των εντόμων σε εθνική και ηπειρωτική κλίμακα, προκειμένου να κατανοηθεί και να αποφευχθεί η εκτεταμένη μείωση των εντόμων. Η Δράση θα ενώσει μια μάζα ερευνητών και ενδιαφερομένων σε τεχνολογίες τεχνητής νοημοσύνης εντόμων που θα βασίζονται σε εικόνες για να κατευθύνουν και να οδηγήσουν την ερευνητική ατζέντα, να δημιουργήσουν ερευνητικές δυνατότητες σε όλη την Ευρώπη και να υποστηρίξουν την καινοτομία και τις εφαρμογές.

Υπάρχουν αυξανόμενες ενδείξεις ότι οι πληθυσμοί των εντόμων σε όλο τον κόσμο βρίσκονται σε απότομη μείωση. Η κατανόηση των τάσεων στα είδη και των οδηγών τους είναι το κλειδί για τη γνώση του μεγέθους της πρόκλησης, των αιτιών της και του τρόπου αντιμετώπισής της. Για τον εντοπισμό λύσεων που οδηγούν σε βιώσιμη βιοποικιλότητα παράλληλα με την οικονομική ευημερία, η παρακολούθηση των εντόμων θα πρέπει να είναι αποτελεσματική και να παρέχει τυποποιημένους και συχνά ενημερωμένους δείκτες κατάστασης για να καθοδηγούν τις δράσεις διατήρησης.

Η στρατηγική της ΕΕ για τη βιοποικιλότητα 2030 προσδιορίζει την κρίσιμη πρόκληση της παροχής τυποποιημένων πληροφοριών σχετικά με την κατάσταση της φύσης και η τεχνητή νοημοσύνη εντόμων που βασίζεται σε εικόνες μπορεί να συμβάλει σε αυτό. Συγκεκριμένα, ο νόμος της ΕΕ για την αποκατάσταση της φύσης πιθανότατα θα θέσει δεσμευτικούς στόχους για τα δεδομένα υψηλής ανάλυσης που μπορούν να παρέχουν οι κάμερες. Έτσι, τα αποτελέσματα της Δράσης θα συμβάλουν άμεσα στην εφαρμογή των πολιτικών της ΕΕ, όπου η παρακολούθηση της βιοποικιλότητας θεωρείται βασικό στοιχείο.

Η δράση COST "InsectAI", με τέσσερα πακέτα εργασίας θα διοργανώσει εργαστήρια, συνέδρια, επιστημονικές αποστολές, hackathons, design-sprints και πολλά άλλα. Αυτές οι ομάδες θα ασχοληθούν με τον τρόπο με τον οποίο οι τεχνολογίες τεχνητής νοημοσύνης εντόμων που βασίζονται σε εικόνες μπορούν να ανταποκριθούν καλύτερα στις κοινωνικές ανάγκες, θα υποστηρίξουν την καινοτομία στο υλικό συλλογής εικόνων, θα δημιουργήσουν τυποποιημένες προσεγγίσεις για την επεξεργασία εικόνας και θα αναπτύξουν νέες μεθόδους ανάλυσης δεδομένων και ενσωμάτωσης για τη μετατροπή των δεδομένων σε χρήσιμες πληροφορίες.

Hungarian

Az InsectAI COST együttműködés célja, hogy támogassa a rovarok hosszú távú megfigyelését és védelmét nemzeti és kontinentális szinten annak érdekében, hogy megértsük és visszafordítsuk a rovarok széleskörű csökkenését. Az együttműködés összefogja a kép alapú rovar mesterséges intelligencia AI technológiák kutatóinak és érintettjeinek kritikus tömegét, hogy irányítsa és vezesse a kutatási agendát, építse a kutatási kapacitást egész Európában, és támogassa az innovációt és alkalmazást.

Egyre több bizonyíték van arra, hogy globálisan a rovarpopulációk csökkennek. Fontos megérteni a fajok változásait és azok kiváltó okait, hogy felmérhessük a csökkenés mértékét és megtalálhassuk a megfelelő megoldásokat. Ahhoz, hogy olyan megoldásokat találjunk, amelyek fenntartható biodiverzitáshoz vezetnek a gazdasági jólét mellett, a rovarmegfigyelésnek hatékonynak kell lennie, és szabványosított, gyakran frissített állapotjelzőket kell biztosítania a védelmi intézkedések irányításához.

Az EU 2030-as biodiverzitási stratégiája azonosítja a természet állapotáról szóló szabványosított információk biztosításának kritikus kihívását, és a képalapú rovar AI hozzájárulhat ehhez. Különösen, az EU természet-helyreállítási törvénye valószínűleg kötelező célokat fog kitűzni a kamerák által biztosított nagy felbontású adatokra vonatkozóan. Így e COST együttműködés eredményei közvetlenül hozzájárulnak majd az EU politikáinak végrehajtásához, ahol a biodiverzitás megfigyelése kulcsfontosságú elemet képez.

Az InsectAI COST együttműködés műhelymunkákat, konferenciákat, rövid távú tudományos utakat, programokat, hackathonokat, design-sprinteket és sok mást szervez négy Munkacsoporton (munkacsomagok) keresztül. Ezek a csoportok azt fogják vizsgálni, hogyan tudják a kép alapú rovar AI technológiák legjobban kielégíteni a társadalmi igényeket, támogatni az innovációt a képgyűjtő hardverekben, létrehozni a képfeldolgozás szabványosított megközelítéseit, és kifejleszteni az új adat-elemzési és integrációs módszereket, hogy az adatokat hasznosítható információkká alakítsák.

Hebrew

תוכנית InsectAI COST תתמוך בניטור ושימור חרקים בקנה מידה לאומי ובישתי על מנת להבין ולנטרל ירידה נרחבת של חרקים. הפעולה תפגיש מסה קריטית של חוקרים ובעלי עניין בטכנולוגיות AI מבוססות על צילום של חרקים כדי לכוון ולהניע את סדר היום המחקרי, לבנות יכולת מחקר ברחבי אירופה ולתמוך בחדשנות וביישום.

ישנן עדויות גוברות לכך שאוכלוסיות החרקים ברחבי העולם נמצאות בירידה חדה. וכן הבנת מגמות בשינוי רמות מינים שונים והסיבות לכך היא המפתח לדעת את גודל האתגר, זיהוי הגורמים לו וכיצד להתמודד איתו. כדי לזהות פתרונות המובילים למגוון ביולוגי בר קיימא לצד שגשוג כלכלי, ניטור חרקים צריך להיות יעיל ולספק מדדים סטנדרטיים לרמות החרקים השונים המתעדכנים לעתים קרובות כדי להנחות פעולות שימור.

אסטרטגיית המגוון הביולוגי של האיחוד האירופי לשנת 2030 מזהה את האתגר הקריטי של אספקת מידע סטנדרטי על מצב האוכלוסיה בטבע, ובינה מלאכותית של חרקים יכולה לתרום לכך. באופן ספציפי, "חוק שיקום הטבע" של האיחוד האירופי יקבע כל הנראה יעדים מחייבים לניתור ואיסוף נתונים ברזולוציה גבוהה שמצלמות יכולות לספק. לפיכך, התפוקות של תוכנית COST יתרמו ישירות ליישום מדיניות האיחוד האירופי, כאשר ניטור המגוון הביולוגי נחשב למרכיב מרכזי.

תוכנית זו שלInsectAI COST תארגן סדנאות, כנסים, משימות מדעיות קצרות טווח, האקתונים, ספרינטים עיצוביים ועוד הרבה יותר, בארבע קבוצות עבודה. קבוצות אלה יתייחסו לאופן שבו טכנולוגיות AI מבוססות-תמונה יכולות לתת מענה בצורה הטובה ביותר לצרכים חברתיים, לתמוך בחדשנות בחומרה לאיסוף תמונות, ליצור גישות סטנדרטיות לעיבוד תמונה ולפתח שיטות חדשות לניתוח נתונים ואינטגרציה להפיכת נתונים לתובנות המובילות לפעולה".

Irish

Tabharfaidh an InsectAI COST Action tacaíocht do stiúradh, monatóireacht agus caomhnú na bhfeithidí ag leibhéil na náisiún agus na mór-roinne le go dtuigfí agus go gcuirfí i gcoinne an meath atá tagtha go forleathan ar mhéid na bhfeithidí.

Tabharfar le chéile grúpa tábhachtach tromchiallach taighdeoirí agus iad siúd go bhfuil dlúthbhaint acu le teicneolaíocht AI na bhfeithidí atá bunaithe ar íomhánna, chun gnothaí taighde a stiúradh agus a chur chun cinn, cumas taighde na hEorpa a chothú, agus tacú le cur chuige agus meon an athraithe.

Tá fianaise láidir go bhfuil daonraí na bhfeithidí timpeall na cruinne ag maolú go géar. Tá sé rí-thábhachtach go dtuigimíd claonta a bhaineann le specis agus na cúiseanna a bhíonn leo, le go dtuigfimíd méid an dúthshláin atá romhainn, na nithe is cúis leis, agus conas tabhairt faoi. Le go dtiocfaimíd ar réitigh a chothóidh bithéagsúlacht inbhuanaithe, chomh maith le rachmas eacnamaíochta, ba cheart go mbeadh monatóireacht na bhfeithidí éifeachtúil agus go solátharódh sé táscairí stádais rialta chun gníomhaíochtaí caomhnaithe a stiúriú.

Aithníonn straitéis bithéagsúlachta an Aontais Eorpaigh 2030 an duthshlán rí-thábhachtach atá ag baint le heolas caighdeánaithe faoin bhail atá ar an dúlra a sholáthar, agus is féidir le AI na bhfeithidí bunaithe ar íomhánna cur le seo. Le bheith sonrach, is dócha go leagfaidh dlí athchóirithe an dúlra de chuid an Aontais Eorpaigh spriocanna éiginteacha amach le haghaidh na sonraí ardtaifigh a fhaighimíd ó cheamaraí. Mar sin, cabhróidh torthaí na gníomhaíochta seo le polasaithe an AE a chur I gcrích, sna cásanna ina bhfuil monatóracht bithéagsúlachta ina ghné lárnach.

Eagróidh an InsectAI Cost Action ceardlanna, comhdhálacha, misin eolaíochta gearr-théarmacha, hacatóin, ráib-dhearaí agus a lán eile thar cheithre ghrúpa oibre. Tabharfaidh na grúpaí seo faoin gceist seo a leanas: conas is féidir le teicneolaíocht na bhfeithidí AI bunaithe ar íomhánna cuidiú le riachtanaisí na sochaí, cur le hathraithe i gcrua-earraí le haghaidh bailiúchán íomhánna, cur chuige caighdeánaithe a chruthú le haghaidh próiseáil íomhánna agus modhanna nua anailíse agus comhtháithithe sonraí a fhorbairt, le go spreagfaidh na sonraí léargais a bheidh so-aistrithe go gníomh.

Italian

La COST Action InsectAI supporterà monitoraggio e conservazione degli insetti su scala nazionale e continentale al fine di comprendere e contrastare il loro diffuso declino. La Action contribuirà a connettere ricercatori ed altre parti interessate in tecnologie IA basate su immagini, raggiungendo una massa critica per dirigere e promuovere programmi di ricerca, sviluppare competenze in Europa, e supportare innovazione ed applicazione di queste tecnologie.

Il rapido declino delle popolazioni di insetti a livello globale è sempre più evidente. Comprenderne le tendenze e i fattori che le influenzano è di fondamentale importanza per individuare le cause e affrontare il problema. Per identificare soluzioni che possano

portare a misure di conservazione della biodiversità sostenibili quanto a benessere economico, il monitoraggio degli insetti deve essere efficiente e produrre indicatori standardizzati e aggiornati frequentemente, con lo scopo di guidare azioni di conservazione.

La Strategia Europea per la Biodiversità 2030 evidenzia quanto sia critico poter contare su informazioni standardizzate sullo stato della natura, e InsectAI può contribuire a fornirle. Specificamente, la Legge Europea sul Ripristino della Natura probabilmente stabilirà obiettivi vincolanti per i dati ad alta risoluzione che possono essere prodotti con videocamere. In questo frangente, i prodotti di questa Action contribuiranno direttamente all'implementazione di direttive Europee, in cui il monitoraggio della biodiversità è considerato un componente chiave.

La COST Action InsectAI organizzerà laboratori, conferenze, missioni scientifiche a breve termine, hackathons, design-sprints e molto altro grazie ai suoi quattro Gruppi di Lavoro. Questi gruppi si occuperanno di come tecnologie IA basate su immagini possano rispondere al meglio ad Esigenze Sociali, supportare innovazione in Sistemi di Raccolta Immagini, creare approcci standard per l'Elaborazione d'Immagini e sviluppare nuovi metodi per l'Analisi Dati e Metodi Integrativi per trasformare flussi di dati in soluzioni concrete.

Latvian

InsectAI COST Action veicinās kukaiņu monitoringu un aizsardzību nacionālā un kontinenta mērogā, lai izprastu un novērstu plaši izplatīto kukaiņu skaita samazināšanos. Šī aktivitāte apvienos būtiski daudz pētnieku un attēlos balstītās mākslīgā intelekta (MI) tehnoloģijās ieinteresēto personu, lai vadītu pētniecības programmu, palielinātu pētniecības jaudu visā Eiropā un atbalstītu inovācijas un prasmes.

Arvien vairāk pierādījumu liecina, ka kukaiņu populācijas visā pasaulē strauji samazinās. Izpratne par tendencēm attiecībā uz sugām un to virzītājspēkiem ir būtiska, lai zinātu izaicinājuma lielumu, cēloņus un to, kā to risināt. Lai atrastu risinājumus, kas nodrošina ilgtspējīgu bioloģisko daudzveidību līdztekus ekonomiskai labklājībai, kukaiņu monitoringam jābūt efektīvam, un tam jānodrošina standartizēti un regulāri atjaunināti stāvokļa rādītāji, pēc kuriem vadīties, lai veiktu aizsardzības pasākumus.

ES "Bioloģiskās daudzveidības stratēģija 2030" paredz, ka svarīgākais uzdevums ir nodrošināt standartizētu informāciju par dabas stāvokli, un uz attēliem balstīta kukaiņu MI tehnoloģija var to veicināt. Konkrēti, ES Dabas atjaunošanas likums, visticamāk, noteiks saistošus mērķus augstas izšķirtspējas datiem, ko kameras var nodrošināt. Tādējādi InsectAI COST Action rezultāti dos tiešu ieguldījumu ES politikas īstenošanā, kur bioloģiskās daudzveidības monitorings tiek uzskatīta par galveno komponenti.

InsectAI COST Action organizēs seminārus, konferences, īstermiņa zinātniskas misijas, hakatonus, dizaina sprintus un daudz ko citu četrās darba grupās. Šīs grupas pievērsīsies tam, kā uz attēliem balstītas kukaiņu MI tehnoloģijas var vislabāk apmierināt sabiedrības vajadzības, atbalstīt inovācijas attēlu ieguves un uzkrāšanas aparatūrā, radīt

standartizētas pieejas attēlu apstrādei un izstrādāt jaunas datu analīzes un integrācijas metodes, lai datus pārvērstu izmantojamās atziņās.

Lithuanian

InsectAI COST veikla rems vabzdžių stebėseną ir apsaugą nacionaliniu ir žemyno mastu, kad būtų galima suprasti ir užkirsti kelią intensyvėjančiam vabzdžių nykimui. Veikla suburs tyrėjų ir suinteresuotųjų šalių, dirbančių su vaizdais besiremiančiomis vabzdžių DI technologijomis, kritinę masę, siekdama nukreipti ir paskatinti tyrimų darbotvarkę, didinti jų pajėgumus visoje Europoje, taip pat remti inovacijas bei tyrimų taikymą.

Daugėja įrodymų, kad vabzdžių populiacijos visame pasaulyje smarkiai mažėja. Rūšių gausumo tendencijų ir jas lemiančių veiksnių supratimas yra raktas šio iššūkio ir jo priežasčių suvokimui bei būtinų sprendimų priėmimui. Siekiant nustatyti sprendinius, kurie padėtų išlaikyti tvarią biologinę įvairovę kartu su ekonomine gerove, vabzdžių stebėsena turėtų būti veiksminga ir numatyti standartizuotus bei dažnai atnaujinamus būklės rodiklius, kuriais remiantis būtų vykdoma gamtosauga.

ES biologinės įvairovės 2030 m. strategijoje numatytas kritinis iššūkis tiekti standartizuotą informaciją apie gamtos būklę, o vaizdais pagrįsta vabzdžių AI gali prie jo prisidėti. Konkrečiau, ES Gamtos atkūrimo įstatymas greičiausiai nustatys privalomus tikslus didelės raiškos duomenims, kuriuos gali pateikti vaizdo kameros. Taigi šios veiklos rezultatai tiesiogiai prisidės prie ES aplinkosaugos politikos, kurioje biologinės įvairovės stebėsena laikoma esminiu komponentu, įgyvendinimo.

InsectAI COST veikla organizuos seminarus, konferencijas, trumpalaikes mokslines misijas, hakatonus, dizaino sprinto ir kitas akcijas keturiose darbo grupėse. Šios grupės spręs, kaip vaizdais pagrįstos vabzdžių AI technologijos gali geriausiai patenkinti visuomenės poreikius, remti vaizdų rinkimo aparatinės įrangos naujoves, kurti standartizuotus vaizdo apdorojimo metodus ir kurti naujus duomenų analizės ir integravimo metodus, skirtus tuos duomenis paversti veiksmingomis prognozėmis.

Maltese

L-azzjoni COST tal-InsectAI se tappoġġja l-monitoraġġ u l-konservazzjoni tal-insetti fuq skala nazzjonali u kontinentali sabiex nifhmu u nikkontrastaw it-tnaqqis mifrux tal-insetti. L-Azzjoni se tiġbor flimkien massa kritika ta' riċerkaturi u partijiet interessati fit-teknoloġiji tal-intelliġenza artifiċjali ibbażati fuq l-immaġni tal-insetti biex tiddirieġi u tmexxi l-aġenda tar-riċerka, tibni kapaċità ta' riċerka madwar l-Ewropa, u tappoġġja l-innovazzjoni u l-applikazzjoni.

Hemm dejjem aktar evidenza li l-popolazzjonijiet ta' insetti madwar id-dinja qiegħdin jonqsu b'mod qawwi. Li nifhmu dawn t-tendenzi u x'qiegħed jikkawżom huwa essenzjali biex inkunu nafu d-daqs tal-isfida, il-kawżi tagħha, u kif nindirizzawha. Biex jiġu identifikati soluzzjonijiet li jwasslu għal bijodiversità sostenibbli flimkien mal-prosperità ekonomika, il-monitoraġġ tal-insetti għandu jkun effiċjenti u jipprovdi indikaturi tal-istatus standardizzati u aġġornati b'mod frekwenti biex jiggwidaw azzjonijiet ta' konservazzjoni.

L-Istrateġija tal-Bijodiversità tal-UE 2030 tidentifika l-isfida kritika li tipprovdi informazzjoni standardizzata dwar l-istat tan-natura, u l-intelliġenza artifiċjali bbażata fuq l-immaġni tal-insetti tista' tikkontribwixxi għal dan. Speċifikament, il-Liġi ta' Restawr tan-Natura tal-UE x'aktarx li se tistabbilixxi miri obbligatorji għal data ta' riżoluzzjoni għolja li l-kameras jistgħu jipprovdu. Għalhekk, il-prodotti tal-Azzjoni se jikkontribwixxu direttament għall-implimentazzjoni tal-politiki tal-UE, fejn il-monitoraġġ tal-bijodiversità huwa kkunsidrat komponent ewlieni.

L-Azzjoni COST InsectAI se torganizza workshops, konferenzi, missjonijiet xjentifiċi ta' żmien qasir, hackathons, design-sprints u ħafna aktar, madwar erba' gruppi ta' ħidma. Dawn il-gruppi se jindirizzaw kif l-aħjar it-teknoloġiji tal-intelliġenza artifiċjali ibbażati fuq l-immaġni tal-insetti jistgħu jindirizzaw il-bżonnijiet tas-soċjetà, jappoġġjaw l-innovazzjoni fl-ħardwer tal-ġbir tal-immaġni, joħolqu approċċi standardizzati għall-ipproċessar tal-immaġni, u jiżviluppaw metodi innovattivi ta' analiżi u integrazjoni tad-data biex id-data tinqaleb f'għarfien azzjonabbli.

Macedonian

COST акцијата „InsectAI" ќе го поддржи мониторингот и зачувувањето на инсектите на национално и меѓународно ниво, со цел да се разбере и да се спротивстави на широко распространетото опаѓање на инсектите. Акцијата ќе обедини критична маса истражувачи и засегнати страни во AI (вештачко-интелигентни) технологиите за инсекти базирани на фотографии за да ја насочи и поттикне истражувачката агенда, да изгради истражувачки капацитет низ Европа и да ги поддржи иновациите и апликациите.

Постои евидентен доказ за наглото опаѓање на популациите на инсектите на светско ниво. Разбирањето на трендовите кај видовите и нивните двигатели е клучна точка преку која се осознава големината на предизвикот, неговите причини и како да се влијае на истиот. За да се идентификуваат решенија кој водат до одржлив биодиверзитет во корелација со економскиот напредок, мониторирањето на инсектите треба да биде ефикасно и да обезбеди стандардизиран и фреквентно ажуриран статус на индикатори кои ќе ги насочуваат постапките за конзервација.

ЕУ стратегијата за биодиверзитет 2030 го идентификува критичниот предизвик за доставување стандардизирана информација за состојбата на природата, а AI технологијата за инсекти базирана на фотографии може да придонесе во тој поглед. Поточно, Законот на ЕУ за обновување на природата најверојатно ќе постави обврзувачки цели за податоци со голема резолуција кои камерите може да ги обезбедат. Оттука, резултатите од Акцијата ќе придонесат за директна имплементација на политиките на ЕУ, каде што мониторингот на биодиверзитетот се смета за клучна компонента.

COST Акцијата InsectAI ќе организира работилници, конференции, краткотрајни научни мисии, хакатони, дизајн-спринтови и многу повеќе, меѓу четири работни групи. Овие групи ќе посочат како AI технологиите за инсекти базирани на

фотографии можат најдобро да одговорат на потребите на општеството, да ја поддржат иновацијата во хардверот за колекција на фотографии, да создадат стандардизирани пристапи за процесирање на фотографиите и да развијат нови методи за анализа на податоци и интеграција за претворање на податоците во функционални согледувања.

Norwegian

InsectAI COST-aksjonen vil støtte insektovervåking og bevaring på nasjonalt og kontinentalt nivå for å forstå og motvirke den utbredte nedgangen i insektpopulasjoner. Aksjonen vil samle en kritisk masse av forskere og interessenter innen bildebaserte insekt-AI-teknologier for å lede og drive forskningsagendaen, bygge forskningskapasitet over hele Europa og støtte innovasjon og anvendelse.

Det er økende bevis for at insektpopulasjoner over hele verden er i kraftig nedgang. Å forstå trender i arter og deres drivere er nøkkelen til å vite omfanget av utfordringen, dens årsaker og hvordan man skal adressere den. For å identifisere løsninger som fører til bærekraftig biologisk mangfold sammen med økonomisk velstand, bør insektovervåking være effektiv og gi standardiserte og ofte oppdaterte statusindikatorer for å veilede bevaringstiltak.

EUs biodiversitetsstrategi 2030 identifiserer den kritiske utfordringen med å levere standardisert informasjon om naturens tilstand, og bildebasert insekt-AI kan bidra til dette. Spesielt vil EUs naturrestaureringslov sannsynligvis sette bindende mål for de høyoppløselige dataene som kameraer kan gi. Dermed vil resultatene av aksjonen bidra direkte til gjennomføringen av EUs politikk, hvor biodiversitetsovervåking anses som en nøkkelkomponent.

InsectAI COST-aksjonen vil organisere workshops, konferanser, kortsiktige vitenskapelige oppdrag, hackathons, design-sprinter og mye mer, på tvers av fire arbeidsgrupper. Disse gruppene vil adressere hvordan bildebaserte insekt-AI-teknologier best kan møte samfunnets behov, støtte innovasjon innen bildeinnsamlingsutstyr, skape standardiserte tilnærminger for bildebehandling og utvikle nye dataanalytiske og integrasjonsmetoder for å gjøre data om til handlingsbare innsikter.

Polish

Akcja COST InsectAI będzie wspierać monitoring i ochronę owadów na poziomie krajowym i kontynentalnym. Działanie to ma na celu zrozumienie przyczyn i przeciwdziałanie spadkowi liczebności owadów. Akcja zgromadzi badaczy i przedstawicieli zainteresowanych stron zajmujących się technologiami sztucznej inteligencji owadów opartej na obrazach. Dzięki temu zostanie zbudowany potencjał badawczy w całej Europie oraz zwiększy się wsparcie dla innowacyjnych zastosowań AI.

Istnieje coraz więcej dowodów na to, że liczebność owadów na całym świecie gwałtownie spada. Zrozumienie trendów dotyczących populacji poszczególnych

gatunków i czynników jakie mogą na nią wpływać jest kluczowe do poznania skali problemu, jego przyczyn jak i możliwych sposobów jego rozwiązania. Monitorowanie populacji owadów powinno być skuteczne i opierte na standaryzowanych metodach. Często aktualizowane wskaźniki dotyczące zmian liczebności pozwolą wyznaczyć kierunki działań ochronnych. Opracowane rozwiązania będą prowadzić do uzyskania dużej różnorodności biologicznej przy jednoczesnym zachowaniu wzrostu gospodarczego.

W Strategii Różnorodności Biologicznej Unii Europejskiej do roku 2030 wskazano kluczowe wyzwanie, jakim jest dostarczanie standardowych informacji o stanie przyrody, a sztuczna inteligencja oparta na obrazach może się do tego przyczynić. W szczególności Ustawa o Przywracaniu Przyrody UE prawdopodobnie ustali wiążące cele w zakresie danych o wysokiej rozdzielczości, których mogą dostarczać kamery. Wyniki Akcji przyczynią się bezpośrednio do wdrażania polityk UE, gdzie monitorowanie różnorodności biologicznej jest uważane za kluczowy element.

Akcja COST InsectAI zorganizuje warsztaty, konferencje, krótkoterminowe misje naukowe i wiele innych w ramach czterech grup roboczych. Grupy te opracują w jaki sposób technologie sztucznej inteligencji oparte na obrazach mogą najlepiej zaspokoić potrzeby społeczne, wspierać innowacje w sprzęcie do gromadzenia obrazów, tworzyć standardowe podejścia do przetwarzania obrazów oraz opracowywać nowatorskie metody analizy i integracji danych w celu ich przekształcania w przydatne rozwiązania.

Portuguese

A ação COST InsectAI apoiará a monitorização e conservação de insetos às escalas nacionais e continentais, com o objetivo de compreender e inverter o declínio generalizado dos insetos. A ação reunirá massa crítica de investigadores e partes interessadas na área das tecnologias de Inteligência Artificial (IA) de insetos baseadas em imagens para impulsionar as agendas de investigação, capacitar a investigação em toda a Europa e apoiar a inovação e a aplicação.

Acumulam-se evidências de que as populações de insetos em todo o mundo estão em declínio acentuado. Compreender as tendências das espécies e os seus fatores determinantes é fundamental para conhecer a dimensão do desafio, as suas causas e a forma de o enfrentar. Para identificar soluções que promovam a biodiversidade de forma sustentável e próspera economicamente, a monitorização dos insetos deve ser eficiente e fornecer indicadores normalizados e atualizados regularmente para orientar ações de conservação.

A Estratégia de Biodiversidade da União Europeia (EU) para 2030 identifica como um desafio crítico o de fornecer informações normalizadas sobre o estado da natureza, e a IA de insetos baseada em imagens pode contribuir para isso. Especificamente, a Lei do Restauro da Natureza da EU seguramente estabelecerá objetivos vinculativos para os dados de alta resolução que as câmaras podem fornecer. Assim, os resultados desta

Ação contribuirão diretamente para a implementação das políticas da UE, nas quais a monitorização da biodiversidade é considerada uma componente fundamental.

A Ação COST InsectAI organizará workshops, conferências, missões científicas de curta duração, hackathons, design-sprints e muito mais, em quatro Grupos de Trabalho. Estes grupos abordarão de que forma as tecnologias de IA de insetos baseadas em imagens podem responder às necessidades da sociedade, apoiarão a inovação no hardware de recolha de imagens, criarão abordagens normalizadas para o processamento de imagens e desenvolverão novos métodos de análise e integração de dados para transformar os dados em conhecimentos acionáveis.

Romanian

Acțiunea COST InsectAI va contribui la înțelegerea și reducerea declinului insectelor prin facilitarea monitorizării și conservării acestora la scară națională și continentală. Acțiunea va aduce împreună o masă critică de cercetători și actori locali cu preocupări în domeniul tehnologiilor ce implică prelucrarea imaginilor cu insecte și inteligența artificială, pentru a promova direcții de cercetare, a dezvolta capacități de cercetare la nivel European și pentru a susține inovarea și măsurile concrete de conservare.

Există tot mai multe dovezi care indică declinul accentuat al populațiilor de insecte la nivel global. Înțelegerea tendințelor la nivel de specie și a motivelor declinului este cheia înțelegerii magnitudinii și cauzelor acestor dezechilibre. Pentru a identifica soluții care să ducă la menținerea biodiversității și la prosperitate economică sustenabilă, monitorizarea insectelor trebuie să fie eficientă și să producă indicatori standardizați care pot fi actualizați frecvent și care să fundamenteze activitățile de conservare.

Strategia UE privind biodiversitatea pentru 2030 identifică producerea de informații standardizate despre starea naturii ca fiind o provocare majoră, iar tehnologiile bazate pe imagini cu insecte și inteligența artificială pot contribui la găsirea unor soluții. De exemplu, Legea UE privind refacerea naturii va stabili ținte obligatorii privind producerea de date cu rezoluție mare, date pe care camerele foto le pot furniza. Astfel, rezultatele produse în cadrul Acțiunii InsectAI vor contribui direct la implementarea politicilor UE în care monitorizarea biodiversității este considerată o componentă principală.

Acțiunea COST InsectAI va organiza workshopuri, conferințe, misiuni științifice pe termen scurt, evenimente de tip hackathon, design-sprint, și multe altele, în cadrul a patru grupuri de lucru. Aceste grupuri vor analiza modul în care tehnologiile bazate pe imagini cu insecte și inteligența artificială pot contribui la satisfacerea Nevoilor Sociale, la generarea de soluții hardware pentru Colectarea de Imagini, la crearea unor metode standardizate de Prelucrare a Imaginilor și la dezvoltarea unor metode noi de Analiză și Integrare a Datelor, pentru a transforma aceste date în cunoștințe ce pot fi puse în practică.

Serbian

InsectAI COST акција ће подржати праћење и очување инсеката на националном и континенталном нивоу како би се разумело и предупредило широко распрострањено опадање бројности инсеката. Да би усмерила и реализовала план истраживања, изградила истраживачке капацитете широм Европе и подстакла иновације и примене, акција ће окупити критичну масу истраживача и других страна заинтересованих за технологије вештачке интелигенције (AI) засноване на анализи слика инсеката.

Постоји све више доказа да су популације инсеката широм света у наглом опадању. Разумевање трендова присутних код различитих врста и шта их покреће јесте кључно за спознавање величине изазова, његових узрока и начина за његово превазилажење. Да би се идентификовала решења која поред економског просперитета воде и ка одрживом биодиверзитету, праћење инсеката би требало да буде ефикасно и обезбеди стандардизована и честа ажурирања индикатора њиховог стања, а у циљу усмеравања акција њиховог очувања.

Стратегија Биодиверзитет ЕУ 2030 идентификује критични изазов пружања стандардизованих информација о стању природе, чему вештачка интелигенција на бази слика инсеката може да допринесе. Нарочито, ЕУ закон о обнови природе ће извесно поставити обавезујуће захтеве за податке високе резолуције које камере могу да пруже. На тај начин исходи Акције директно ће допринети имплементацији политика ЕУ у којима се праћење биодиверзитета сматра кључном компонентом.

COST акција InsectAI организоваће радионице, конференције, краткотрајне научне мисије, хакатоне, брзо осмишљавање решења и још много тога, а све кроз четири радне групе. Ове групе ће се бавити тиме како AI технологије на бази слике намењене инсектима могу на најбољи начин да разреше друштвене потребе, подрже иновације у хардверу за прикупљање слика, створе стандардизоване приступе за обраду слике и развију нове методе анализе и интеграције података, а како би се подаци претворили у директне увиде који ће омогућити деловање.

Slovak

Akcia InsectAI COST podporí monitorovanie a ochranu hmyzu na národnej a kontinentálnej úrovni s cieľom pochopiť a čeliť rozšírenému poklesu počtu hmyzích druhov. Spojí dostatočný počet výskumníkov a zainteresovaných strán v technológiách umelej inteligencie na analýzu obrazu hmyzu, aby usmerňovala a podporovala výskumnú agendu, budovala výskumné kapacity po celej Európe a podporovala inovácie a aplikácie.

Existuje čoraz viac dôkazov, že populácie hmyzích druhov na celom svete prudko klesajú. Pochopenie trendov zmien v populáciách druhov a faktorov, ktoré tieto zmeny spôsobujú, je kľúčové pre určenie rozsahu výzvy, jej príčin a riešení. Aby sme našli riešenia pre udržateľnú biodiverzitu a ekonomický rozvoj, monitorovanie hmyzu musí byť

efektívne a poskytovať štandardizované a často aktualizované indikátory stavu na usmernenie ochranných opatrení.

Stratégia EÚ v oblasti biodiverzity do roku 2030 identifikuje zásadnú výzvu spočívajúcu v zabezpečení štandardizovaných informácií o stave prírody a technológie umelej inteligencie na analýzu obrazu hmyzu k tomu môžu prispieť. Konkrétne, nariadenie EÚ „O obnove prírody" (Nature Restoration Law) pravdepodobne stanoví záväzné ciele pre údaje s vysokým rozlíšením, ktoré môžu poskytovať kamery. Výstupy akcie teda priamo prispejú k implementácii politík EÚ, kde je monitorovanie biodiverzity považované za kľúčovú zložku.

Akcia InsectAI COST bude organizovať workshopy, konferencie, krátkodobé vedecké misie, hackathony, dizajn šprinty a ďalšie aktivity v rámci štyroch pracovných skupín. Tieto skupiny sa budú zaoberať tým, ako môžu technológie umelej inteligencie na analýzu obrazu hmyzu najlepšie riešiť spoločenské potreby. Budú sa zamieravať na inovácie hardvéru na zber obrazových dát, vytvárať štandardizované prístupy pre spracovanie obrazových informácií a vyvíjať nové metódy analýzy a integrácie dát na premenenie týchto informácií na použiteľné poznatky.

Slovenian

Akcija COST InsectAI bo podpirala spremljanje in ohranjanje žuželk na nacionalni in kontinentalni ravni, da bi razumeli in preprečili obsežen upad števila žuželk. Akcija bo združila kritično maso raziskovalcev in deležnikov na področju tehnologij umetne inteligence za prepoznavanje žuželk s slikami, da bi usmerjala in vodila raziskovalno agendo, gradila raziskovalne zmogljivosti po vsej Evropi ter podpirala inovacije in uporabo.

Vse več dokazov je, da populacije žuželk po vsem svetu hitro upadajo. Razumevanje trendov pri vrstah in njihovih dejavnikov je ključnega pomena za spoznavanje obsega problema, njegovih vzrokov in načinov za reševanje. Za identifikacijo rešitev, ki vodijo do trajnostne biotske raznovrstnosti skupaj z gospodarskim blagostanjem, mora biti spremljanje žuželk učinkovito ter zagotavljati standardizirane in pogosto posodobljene kazalnike stanja za usmerjanje ohranitvenih ukrepov.

Strategija EU za biotsko raznovrstnost do leta 2030 prepoznava kritični izziv zagotavljanja standardiziranih informacij o stanju narave, pri čemer lahko prispevajo tehnologije umetne inteligence za prepoznavanje žuželk s slikami. Konkretno, Zakon o obnovi narave EU bo verjetno postavil zavezujoče cilje za podatke visoke ločljivosti, ki jih lahko zagotovijo kamere. Tako bodo rezultati Akcije neposredno prispevali k izvajanju politik EU, kjer se spremljanje biotske raznovrstnosti šteje za ključno komponento.

Akcija COST InsectAI bo organizirala delavnice, konference, kratke znanstvene obiske, hekatone in še veliko več v okviru štirih delovnih skupin. Te skupine se bodo ukvarjale s tem, kako lahko tehnologije umetne inteligence za prepoznavanje žuželk s slikami najbolje zadovoljijo družbene potrebe, podpirajo inovacije v strojni opremi za zbiranje

slik, ustvarjajo standardizirane pristope za obdelavo slik in razvijajo nove metode za analizo in integracijo podatkov za pretvorbo podatkov v uporabne vpoglede.

Spanish

La acción InsectAI COST apoyará el monitoreo y la conservación de insectos a escala nacional y continental para entender y contrarrestar el declive generalizado de insectos. La acción reunirá a un gran número de investigadores y partes interesadas en tecnologías de IA basadas en imágenes de insectos para dirigir e impulsar la agenda de investigación, desarrollar la capacidad de investigación en toda Europa y apoyar la innovación y la aplicación.

Hay evidencias crecientes de que las poblaciones de insectos en todo el mundo están en fuerte declive. Entender las tendencias en las especies y sus impulsores es clave para conocer la magnitud del desafío, sus causas y cómo abordarlo. Para identificar soluciones que conduzcan a una biodiversidad sostenible junto con la prosperidad económica, el monitoreo de insectos debe ser eficiente y proporcionar indicadores de estado estandarizados y frecuentemente actualizados para guiar las acciones de conservación.

La Estrategia de Biodiversidad de la UE 2030 identifica el desafío crítico de proporcionar información estandarizada sobre el estado de la naturaleza, y la IA basada en imágenes de insectos puede contribuir a esto. Específicamente, la Ley de Restauración de la Naturaleza de la UE probablemente establecerá objetivos vinculantes para los datos de alta resolución que las cámaras pueden proporcionar. Por lo tanto, los resultados de la acción contribuirán directamente a la implementación de las políticas de la UE, donde el monitoreo de la biodiversidad se considera un componente clave.

La acción InsectAI COST organizará talleres, conferencias, misiones científicas a corto plazo, hackatones, sprints de diseño y mucho más, en cuatro Grupos de Trabajo. Estos grupos abordarán cómo las tecnologías de IA basadas en imágenes de insectos pueden satisfacer mejor las necesidades sociales, apoyar la innovación en el hardware de recolección de imágenes, crear enfoques estandarizados para el procesamiento de imágenes y desarrollar nuevos métodos de análisis e integración de datos para convertir los datos en conocimientos accionables.

Swedish

COST Action InsectAI kommer stödja insektsövervakning och bevarandeåtgärder på nationell och internationell nivå, med syfte att förstå och motverka den pågående minskningen av insekter. Denna Action kommer sammanföra forskare och intressenter inom bildbaserad AI-teknik för insektsstudier för att driva forskningsagendan framåt, bygga upp forskningskapacitet i hela Europa samt stödja innovation och tillämpningar.

Det finns allt tydligare bevis för att insektspopulationer runt om i världen minskar kraftigt. Förståelse för arters dynamik och de bakomliggande drivkrafterna är nyckeln till att förstå omfattningen av detta problem, dess orsaker, och hur det ska hanteras. För att kunna

identifiera lösningar som gynnar såväl biologisk mångfald som ekonomiskt välstånd behövs effektiv insektsövervakning med standardiserade och frekvent uppdaterade statusindikatorer som underlag för bevarandeåtgärder.

EU:s strategi för biologisk mångfald för 2030 identifierar förmågan att leverera standardiserade data om naturens tillstånd som en kritisk utmaning. Bildbaserad AI-teknologi kan bidra till att leverera standardiserad information för insekter. Mer specifikt kommer EU:s naturrestaureringslag sannolikt att sätta bindande mål för den typ av högupplöst data som kameror kan leverera. Med andra ord kommer resultaten av denna Action bidra direkt till genomförandet av EU:s politik, där övervakning av biologisk mångfald kommer vara en central del.

COST Action InsectAI kommer organisera workshops, konferenser, forskarutbyten, hackathons, design-sprintar och mycket mer, organiserat i fyra arbetsgrupper. Grupperna kommer arbeta med hur insektsinriktad, bildbaserad AI-teknologi bäst kan tillgodose samhällets behov, stödja innovation inom hårdvara för bildinhämtning, skapa standardiserade metoder för bildbehandling och utveckla nya metoder för dataanalys och dataintegration som omvandlar data till praktiskt tillämpbara beslutsunderlag.

Turkish

InsectAI COST eylemi, yaygın böcek azalmalarını anlamak ve bunlara karşı koymak için ulusal ve kıtasal ölçekte böcek izleme ve korumayı destekleyecektir. Eylem, araştırma gündemini belirlemek ve yönlendirmek, Avrupa genelinde araştırma kapasitesi oluşturmak ve inovasyonu ve uygulamayı desteklemek için görüntü tabanlı böcek AI teknolojilerinde kritik bir araştırmacı ve paydaş kitlesini bir araya getirecektir.

Dünya genelinde böcek popülasyonlarının hızlı bir şekilde azaldığına dair artan kanıtlar bulunmaktadır. Türlerdeki eğilimleri ve azalmaya neden olan itici güçleri anlamak, sorunun boyutunu, nedenlerini ve bununla nasıl başa çıkılacağını bilmek için önemlidir. Ekonomik refahın yanı sıra sürdürülebilir biyoçeşitliliğin sağlanmasına yönelik çözümleri belirlemek için etkin böcek izleme yöntemleri gereklidir. Bunun yanında koruma eylemlerine rehberlik etmek için standartlaştırılmış ve sık sık güncellenen gözlem süreçleri oluşturulmalıdır.

AB Biyoçeşitlilik Stratejisi 2030, doğanın durumu hakkında standartlaştırılmış bilgi sunmanın kritik zorluğunu belirler ve görüntü tabanlı böcek AI buna önemli katkıda bulunabilir. Özellikle, AB Doğa Restorasyon Yasası muhtemelen kameraların sağlayabileceği yüksek çözünürlüklü veriler için bağlayıcı hedefler belirleyecektir. Böylece, Eylemin çıktıları, biyolojik çeşitlilik izlemenin temel bir bileşen olarak kabul edildiği AB politikalarının uygulanmasına doğrudan katkıda bulunacaktır.

InsectAI COST Eylemi, dört Çalışma Grubunda atölyeler, konferanslar, kısa süreli bilimsel görevler, hackathon'lar, tasarım sprint'leri ve çok daha fazlasını düzenleyecektir. Bu gruplar, görüntü tabanlı böcek AI teknolojilerinin Toplumsal İhtiyaçları en iyi şekilde nasıl karşılayabileceğini, Görüntü Toplama donanımında yeniliği nasıl destekleyebileceğini, Görüntü İşleme için standartlaştırılmış yaklaşımlar nasıl oluşturabileceğini ve verileri

eyleme dönüştürülebilir içgörülere dönüştürmek için yeni Veri Analizi ve Entegrasyon yöntemleri nasıl geliştirebileceğini ele alacaktır.

State of the art

There is mounting evidence that populations of insects around the world are in sharp decline (Hallmann et al. 2017, Seibold et al. 2019) and the drivers of these declines are variable (Wagner et al. 2021). To identify solutions that lead to sustainable biodiversity alongside economic prosperity, insect monitoring should be efficient and provide standardised and frequently updated status indicators to guide conservation actions.

Understanding trends in species and their drivers is key to knowing the size of the challenge, its causes and how these factors vary in both space and time. In order to know this, we need robust methods for monitoring species that minimise bias and maximise the quantity and quality of data collected. Due to the recent success of artificial intelligence (AI) algorithms in other domains and applications, new image-based and AI-assisted tools, alongside traditional methods, are likely to be critical for meeting this information need.

Insect observations are traditionally collected in the field by trained entomologists using one of a suite of established methods, such as malaise traps to catch flying insects or moth traps that lure in individuals using bright or UV lights. Many of these systems are lethal, killing the insects they seek to study and all require significant investment in time and expertise. Once captured, the insects are usually taken to the laboratory for identification by taxonomic experts and then conserved and stored in collections. In parallel with such 'professional' survey methods, there has been a rise in digitally-enabled citizen science. Using mobile applications, members of the public collect images of insects and submit these to online biodiversity-recording platforms where other users aid in identification. In this way, the role of the citizen scientists in collecting observations of insects has increased dramatically.

Rapid advances are being made by researchers in Europe and across the world in the application of machine-learning methods (a subset of AI) to the challenge of understanding insect ecology (Høye et al. 2022). This work includes the development of algorithms (typically deep-learning methods, hereafter referred to as 'AI'), for automatically detecting and identifying individuals, as well as imaging hardware to collect images in the laboratory or the field. Much of this work has been undertaken in the past 5 years and is mostly at the proof-of-concept phase. This work crosses multiple disciplines including engineering, computer sciences, entomology and statistics and has the potential to revolutionise the way we monitor insect biodiversity (van Klink et al. 2022).

Bulk image collection by cameras are set to lead to an explosion in image data for insects. The state-of-the-art systems fall into two designs. The first are systems deployed in the field that use digital cameras and attractants to take images of insects, which are then stored locally or transmitted to the cloud. These systems are often solar powered

allowing long duration and hands-off deployment. Examples of these systems include the AMMOD system (Wägele et al. 2022), Aarhus moth trap (Bjerge et al. 2021), PICT (Droissart et al. 2021), Sticky Pi (Geissmann et al. 2022), NEWTRAP (Didry et al. 2019) and Diopsis insect camera (www.diopsis.eu), all of which are in the pilot phase. The second type of design are benchtop systems that aspire to semi-automate the classification of collected insects in a laboratory setting. These systems use macro cameras to take large numbers of images of insects and employ AI algorithms to assist in identification. The only two projects known to have produced proof-of-concept units - BIODISCOVER (Ärje et al. 2020) and Biodiversity scanner (Wührl et al. 2021) - are in their infancy, but they show great promise.

AI algorithms are having a seismic impact across industries and are already beginning to re-define the landscape of insect identification. Combined with bulk image collection systems, these algorithms lead to rapid species identification with uncertainty estimations. When built into citizen-science applications, these algorithms perform two roles:

1. They undertake the classification of species that are easier to identify, freeing up the time of experts to focus on harder identification tasks and
2. they provide rapid feedback to the citizen scientist, helping to guide them to the correct identification and providing instant gratification. Applications of insect AI in citizen-science platforms are being led in Europe by projects such as Observation.org and Artsdatabanken.

Given the novelty of these image collection and AI technologies, downstream infrastructure, training data repositories and methods for analysing outputs are mostly just ideas or even completely absent. Data storage solutions for these vast datasets are currently one-off systems, with no unified long-term solution. Metadata is not standardised, limiting the ability to combine image datasets and outputs from AI algorithms. Statistical approaches for analysing these data to assess spatial and temporal patterns are practically absent. Methods are absent for integrating data from these novel technologies with traditional monitoring data or data generated by other new technologies (e.g. acoustic, RADAR and molecular methods). European projects, such as ARISE (van Ommen Kloeke et al. 2022), MAMBO (http://mambo-project.eu/) and Easy-RIDER (https://gtr.ukri.org/projects?ref=NE%2FW004216%2F1), are looking to develop workflows and standards, while global assessments of biodiversity trends, such as GLiTERS (https://glitrs.ceh.ac.uk/), are developing standards of data integration which would be relevant to this area.

The state-of-the-art in insect monitoring using AI is rapidly moving, on multiple fronts. Given these challenges and the potential game-changing impacts of these methods, the **InsectAI COST Action** is needed to foster innovation targeted at societal benefit, to build capacity and to promote international collaboration to support this swiftly developing domain.

The Challenge

"**How should image-based and AI-assisted tools be developed and applied to support insect monitoring and conservation at the national and continental scale to understand and counteract widespread insect declines**?"

This is the key challenge that the **InsectAI COST Action** will address. Insect AI technologies have emerged at a time of heightened awareness of global declines in insect populations, as well as specific examples of rapid losses of insects in Europe (Pilotto et al. 2020). The **EU Biodiversity Strategy 2030** identifies the critical challenge of delivering standardised information about the state of nature and image-based insect AI can contribute to this. Eventually, such AI-based monitoring could aid in tracking restoration targets for specific habitats in relation to the forthcoming **EU Nature Restoration Law** and also enhance the quantitative monitoring capacity of the Habitats Directive. Outputs of the Action will contribute directly to **EU policies implementation**, where biodiversity monitoring is considered a key component. These methods are not only relevant for monitoring on-going declines, but are also fundamental to identifying ways to reverse these negative trends, shaping policy- and decision-making. To achieve this, the standardised data coming from sensors should be exploited at the international scale where, for example, EU policy instruments operate and legislation relevant to insect conservation exists. Furthermore, the use of citizen-science apps to monitor community-led conservation efforts allows greater insight into the impact of land management on insect populations.

New image-based insect AI technologies need to work with, and not against, traditional taxonomic expertise. AI may help to automate trivial tasks creating space for experts to take on more complex tasks. At the same time, incorporating expert knowledge in the design of AI algorithms may increase their performance and will help to build trust in the results delivered by AI.

When considering an approach to address this key challenge, further sub-challenges appear that need to be considered by the Action's working groups (WG):

1. What are the specific societal challenges where insect AI technologies can have the greatest impact for understanding and counteracting widespread insect declines (WG1)?
2. How can the community work together to drive innovation, as well as support exploitation and good practice (WG1-4)?
3. How do we build scientific capacity in the European research community needed to take advantage of these new technologies (WG1-4)?

The **InsectAI COST Action** will address the key challenge and sub-challenges through a programme of activities engaging researchers and stakeholders from across disciplines and geographies.

Approach to the challenge and progressing beyond the state of the art

The Action will address the key challenge in three ways:

1.   The Action will **engage stakeholders** to ensure that developments in image-based insect AI technologies are driven by societies' needs and are disseminated effectively to support exploitation (WG1).
2.   The Action will instigate and **nurture innovation and knowledge exchange** in image-based insect AI technologies and develop standards and best practices to support impactful exploitation (WG1-4).
3.   The Action will run an ambitious and inclusive programme of **training** to **build capacity** amongst researchers across Europe (WG1-4).

The widespread declines in insect populations globally have multiple drivers and impacts. The Action will **engage stakeholders** around key issues which are relevant and timely in the European policy context. These issues will be identified through a series of engagement activities (WG1) and are likely to include pollinator monitoring, invasive alien species and impact assessment of farming practices. The Action's stakeholder engagement activities will bring together participants across disciplines to design innovative applications of image-based insect AI technologies that will address these key issues (WG1-3). Bringing together engineers, computer scientists, entomologists and stakeholders (from national government to local managers), the Action will support rapid design iteration and testing of available technologies, jump starting innovation, which is often held back by collaborations siloed within disciplines (WG2-4).

Across Europe, multiple teams are developing field and laboratory camera systems for insects, AI-assisted citizen-science apps and AI algorithms for insect detection and classification. There have been recent efforts in some of these areas to facilitate collaboration, notably the Easy-RIDER project; however, these have been limited to virtual events. These efforts have demonstrated a willingness for international coordination and collaboration. This Action will provide the support to capitalise on the community's appetite and support **innovation** and **knowledge sharing** in the following ways:

1.   Activities aimed at bringing together the current leaders in the field will support the exchage of ideas, comparing hardware and demonstration of hardware to invited stakeholders (WG1 and 2).
2.   Computer scientists and entomologists will be brought together to identify bottlenecks in the development of AI algorithms and develop collaborations to address these issues (WG1 and 3).
3.   The Action will support a programme of activities to bring together hardware and software developers with key stakeholders in the global biodiversity standards community (including both GBIF and TDWG). Participants will develop global metadata standards for FAIR data (data which are findable, accessible, interoperable and reusable) generated by insect AI technologies (WG2 and 3).

4.   The Action will create opportunities to work directly with citizen science and maker communities, to co-design hardware and to trial the integration of image-based insect AI technologies with existing citizen-science activities (WG2).

5.   The action will bring together statisticians, data scientists and ecologists to generate a toolbox for analysing AI output, as well as integration with data from traditional sources and other emerging monitoring technologies (WG4).

6.   Stakeholders will be engaged throughout the action to ensure the societal relevance (WG1) of the outcomes from across the WGs.

In order to realise the potential of these technologies, **training** is needed to **build capacity** amongst European researchers. Adoption of these technologies will require researchers to move from a paradigm of 'interdisciplinary collaboration' to 'trans-disciplinary individuals'. The next generation of ecologists will not only need to develop collaborations with computer scientists, as they do now, but will need to develop the skills to use computer-science techniques. This transition requires that image-based insect AI technologies are developed to be used by ecologists and that ecologists are trained in the key concepts of these technologies. The Action will contain an ambitious training programme for future leaders of image-based insect AI technologies (WG2-4), including a minimum of three Training Schools. Trainees will have access to the knowledge and experience of the current pioneers across Europe through curated training activities and will become the first generation of researchers to realise the potential of image-based insect AI technologies beyond proof of concept studies.

Objectives

The Action's **research coordination objectives** aim to develop a common understanding of the opportunities and challenges for image-based insect AI technologies and build a coordinated approach to our research, to the benefit of all involved.

1.   The Action will **identify pressing challenges** for image-based insect AI early on and shape the research agenda over its 4 years to address existing bottlenecks (WG1-4).

2.   The Action will create opportunities for the **side-by-side assessment** of image collection technologies, AI models and training datasets (WG1 and 2).

3.   The Action, by bringing together the key stakeholders in the image-based insect AI community, will **build agreed data standards** for image-based insect AI technologies (WG1-4) as legacy by the end of the action.

4.   The Action will deliver a **toolbox of analytical methods** updated throughout the action (WG4) including combined analysis of image-based data and traditionally collected data and integration with other technologies, such as acoustics, radar and molecular methods.

5.   The Action will produce **good practice guides** to support the sustainable uptake of image-based insect AI technologies by the key stakeholders and the scientific community to understand and counteract widespread insect declines (WG1-4) and which will be widely disseminated by the end of the action.

The Action's **capacity-building objectives** will create a critical mass of researchers that will be able to drive forward innovations and applications of image-based insect AI technologies.

1. The Action will bring together stakeholders (from national government to local community groups) and technologists to **ensure societies' needs are at the centre of the research agenda** (WG1), in a co-creation practice to be promoted throughout the entire action.
2. The Action will build a programme of knowledge exchange which will support **innovation and capacity building** around image-based insect AI technologies (WG1-4) to be implemented early on and promoted during the whole Action.
3. The Action will ensure **inclusiveness** at its activities and within the Core Group (comprising Chair, Vice-Chair, Working Group leaders, STSM coordinator, Communications manager and YRI coordinator), with a target of 50:50 gender balance, 50% young researchers and innovators (YRIs) and > 50% participation from ITC countries, promoting collaborative activities and mentoring support where needed during its entire duration.

Added value of networking to science and technology excellence

The Action will bring together leading figures in the development of state-of-the-art insect monitoring technologies. The expertise and knowledge that these leaders represent have been established through a range of recent projects and other networking activities at national, European and international scale.

A number of projects have focused on the development of hardware systems for image collection in the field and the laboratory, such as the Diopsis, AMMOD and Aarhus traps and the Biodiscover and DiversityScanner laboratory systems. The Action will add value to these previous efforts by bringing together experts to **develop best practice**, deliver **capacity building** training and run **networking activities** to connect these innovators to the **stakeholder communities** that can use these to address **societal challenges**.

Existing European funded projects such as MAMBO, STING, ARISE and SPRING include activities to explore the application of new technologies to monitor insects. The Action will add value to these projects by creating a forum for cross-project dialogue. Through this forum, the Action will facilitate the exchange of knowledge and experience of the state-of-the-art and provide a mechanism to widen and deepen projects' impact, shaping training and knowledge creation activities planned by the Action.

Efforts to engage citizen scientists in the monitoring of insects will benefit significantly from the work of this Action. EUPoMs and the SPRING project are funded to develop pollinator monitoring across Europe, in part to meet the aspirations of the EU Biodiversity Strategy 2030 and the EU Nature Restoration Law. These projects are exploring citizen science as a data source and stand to gain significantly from the capacity building and innovation opportunities that the Action will provide.

The Royal Entomological Society has published its Grand Challenges in Entomology (https://www.royensoc.co.uk/grand-challenges-in-entomology-project/). The advances in technology that the Action will support, as well as the communication and capacity building activities, will directly address these challenges and, in so doing, support the entomological community across Europe.

International efforts to monitor the state of the world's nature and the drivers of change, such as the GLiTERS project, will benefit from the new stream of monitoring data that will be provided by image-based insect AI technologies in the future. Furthermore, the Action will develop the analytical toolbox needed to integrate these data with existing datasets, setting the stage for these data to form a part of future national and international assessments of the state of insect populations.

Efforts to standardise biodiversity data are led by a consortium of organisations around the world (such as GBIF and TDWG). This Action will bring together the key researchers in the field and this consortium to develop and agree a FAIR data standard for image-based insect AI technologies.

Added value of networking to impact

This Action is interdisciplinary, calling on the participation of engineers, computer scientists, ecologists, taxonomists, museum curators, statisticians and citizen scientists in order to achieve its objectives and meet the key challenge. Our proposed network contains the critical mass and expertise needed for all of these domains.

The Action will draw on hardware expertise from projects across Europe which are developing hardware for the bulk collection of imagery, including AMMOD, MAMBO, Easy-RIDER and ARISE. These projects have experience in designing and deploying image collection systems.

Developments in AI at a number of national centres for biodiversity monitoring, as well as within research groups in computer science institutes, will be leveraged by the Action. National and international centres of biodiversity monitoring also have expertise in curation of FAIR data and developing robust standards. The Action will seek to draw on this expertise (including at GBIF and TDWG) and work to develop FAIR data standards, for our community. The Proposer Network includes members from the USA and Canada who link the Action to relevant Activities in North America.

It is key for the success of these technologies that the entomology, including taxonomy, communities are engaged with and supportive of the Action. The Action will reach out to entomological societies across Europe ensuring the activities are informed by priorities identified by stakeholders within the entomological community (WG1). Understanding and acknowledging the motivation of entomologists to engage with image-based insect AI will be critical to the adoption of these approaches. The forthcoming publication on Grand Challenges for Entomology (https://www.royensoc.co.uk/grand-challenges-in-entomology-project/) outlines a set of key global challenges agreed by entomologists as

priorities including themes relevant to the Action (taxonomy, methods and techniques, anthropogenic impacts, conservation options, ecosystem benefits, technology and resources, knowledge access, training and collaboration, society engagement).

The Action will reach the wider community of conservation technologists by developing partnerships with existing projects and organisations that have built communities around this topic. The Action will draw on the expertise of the WILDLABS platform, which hosts webinars and forums for conservation technologists and the Easy-RIDER project which hosts a WILDLABS group for automated camera traps for insects and which runs webinars on this topic.

Geographic inclusivity is fundamental for this action. Existing research in this field is centred in north-western Europe. Yet, the technologies are likely to have their greatest impact and face their greatest challenges in other parts of Europe where insect biodiversity is much higher and image reference libraries are less well-developed. It is, therefore, crucial that we have engagement from ITC countries. The Action already has significant involvement from ITC countries amongst its proposers (> 53%) and this will be further built during the Action by seeking contact with ITC researchers through existing EU projects and infrastructures such as SPRING, EuropaBON, BiodivERsA+, European Environment Agency, Joint Research Centre and the Knowledge Centre for Biodiversity.

Commercial organisations have a role to play as developers of hardware and generators of data. The network of proposers has some membership from industry already; however, the Action will identify and engage with industry members from hardware development (e.g. AI-enhanced cameras), mobile development (e.g. wildlife app developers) and agri-, silvi- and horticulture.

The Action will undertake an innovative co-design event with maker communities. Maker communities consist of hobbyists who have a shared interest in crafts, electronics, technologies etc. and come together to work on projects and socialise. These communities are motivated to work on projects that support the public good and the environment. Some members of the proposer network are members of makerspaces; however, the Action will widen its connection with this community through successful initiatives, such as the fabfoundation, the EU funded European Maker Week and the EC Joint Research Centre in Ispra, Italy, which has its own makerspace and could host maker events.

Engaging stakeholders

The Action will identify stakeholders with interests in the deliverables of this Action in three key domains:

1. Research organisations and initiatives which are developing, working with, or could have an interest in the technologies.
2. Commercial organisations who are, or could be, involved in the development of hardware.

3.　　Governments and government agencies with a responsibility for monitoring insect biodiversity who could be interested in deploying this hardware to meet their monitoring obligations.

The Action will perform a two-step stakeholder survey. First, the Action will identify key stakeholders across professions and localities for interviews to identify additional stakeholders. Second, the Action will undertake an elicitation exercise that will be run with partners in organisations with existing connections across European industry, academia and government to map their knowledge and expected future use of image-based insect AI technologies (task 1.1).

Once identified, the Action will involve stakeholders in both online and in-person events, such as demonstration events of existing tools, making them aware of possibilities and limitations (tasks 2.1 and 2.3), hackathons (task 3.3) and 'BionicBlitzes' where the image collection and processing will be demonstrated alongside traditional methods to highlight the current state-of-the-art (task 2.4). In addition, articles will be targeted at publications most relevant to the audience for each piece, to include in popular science magazines and online fora (e.g. The Royal Entomological Society's magazine, 'The Antenna' and 'The Conversation').

Communication campaigns (through social media and including short animations) will be developed for specific audiences identified during our stakeholder mapping (task 4.1 and "Plan for dissemination and dialogue" section) including amateur entomologists, researchers and decision-makers. Specifically for the general public, the Action will devise campaigns that build on existing materials available through entomological societies to highlight the importance of insects to ecosystem functioning (Dangles and Casas 2019) and the role that image-based insect AI technologies can play in helping us to understand insects.

The action is proposed at a critical time for policy development and implementation at the EU level, specifically the EU Biodiversity Strategy and the EU Nature Restoration Law. The Action will liaise with the Joint Research Centre and the Knowledge Centre for Biodiversity to ensure the Action's Core Group is kept informed of discussions about a Biodiversity Monitoring Coordination Centre for Europe. At the project level, the Action will coordinate with EuropaBON, BiodivERsA+, SPRING and relevant Horizon Europe projects. Our consortium members will stay in close contact with national biodiversity platforms (e.g. the national nodes of LifeWatch ERIC e-Infrastructure on Biodiversity and Ecosystem Research) to facilitate uptake and implementation of the Action technological developments at national level.

Impact for science and society

In the **short-term** (within the timeframe of the COST Action), the Action will:

1.　　Work with stakeholders to identify the critical societal needs that can benefit from image-based insect AI technologies and develop a roadmap to realising these

opportunities. This will have a direct societal impact by shaping the direction of the entire Action.

2. Initiate and foster collaboration in development of, requirements for and best practice of, large-scale deployable cameras (both in field and laboratory) coupled with AI through workshops, reports and scientific publications. This work will accelerate the rate at which these technologies can be deployed across Europe.

3. Establish pipelines for image collection, processing and output analysis through the development of standards, open-source toolboxes and training activities. This will ensure that future research will follow best practices and provide the best chance of effectively addressing societies' needs for accurate and reliable data.

4. Pave the way for integration of image based-AI with traditional data sources and other insect monitoring technologies through workshops and published reports.

5. Ensure image-based insect AI technologies benefit professionals and lay experts by bringing them together with researchers and training the next generation of insect and technology-literate scientists through Training Schools. This work will support science and technology innovation, creating the future leaders in this field.

In the **medium-term** (in the years after the Action is completed), the Action will:

1. Lead to the development of affordable, scalable and reliable systems for bulk image collection and automated identification, of insects in the field and the laboratory with the potential for innovation and breakthroughs in the scale and accuracy of these systems.

2. Build a self-sustaining and growing community of users/practitioners skilled in using, improving and teaching the next generation of trans-disciplinary individuals.

3. Increase the knowledge of these new technologies amongst stakeholders. This will lead to impacts through the application of these technologies by stakeholders to address societies' key challenges.

4. Expand the network of researchers beyond Europe to accelerate innovation, increase inclusivity and see the application of the technologies in parts of the world where knowledge is most needed.

5. Increase the cost-efficiency of data collection by integrating novel methodologies with traditional approaches. This will lead to better spatial and temporal resolution of insect trends.

In the **long-term** this Action will:

1. Improve the management and protection of global insect populations by helping us to better understand and counteract widespread insect declines.

2. Further develop and integrate the technologies of automated insect monitoring and its application in nationwide and global insect monitoring schemes.

3. Improve geographical, age and gender balance in the research community developing and using novel technology for biodiversity monitoring.

Measures to maximise impact

Knowledge creation, transfer and career development

The Action's activities will lead to **knowledge creation** across societal needs, hardware design, AI algorithms and data analysis and integration. The impact of this work will be ensured by publishing in open access reports and papers, sharing tools openly (e.g. via GitHub) and making all materials available on the Action's website. The Action's inclusivity strategy and approach to stakeholder engagement will ensure that access to knowledge is inclusive and that key stakeholders are engaged throughout.

Transfer of knowledge will be critical to the success of the Action and exploitation of these technologies. Three Training Schools are planned throughout the Action: 1) and 2) Introduction to image-collection systems and AI-assisted tools including practical sessions (one on laboratory systems and one on field systems); 3) Introduction to an analytical toolbox for working with AI output. Summaries of the Training Schools will be delivered by the participants as on-line webinars available through the Action website and materials from the Training Schools, including recordings, code and presentations will also be shared. We will align with other training activities in Europe, for example, the EU pollinator academy in development as part of the EU pollinator initiative.

To facilitate the transfer of knowledge amongst researchers and practitioners, the Action Communication Manager will develop a detailed engagement plan. This will be informed by an on-line survey to identify the needs and motivations of the insect science community within the context of EU biodiversity policies (e.g. EU Biodiversity Strategy (2030), EU Nature Restoration Law and EU Pollinator Initiative) and considering which image-based insect AI technologies will be most impactful for society (see WG1). The plan will be further refined, alongside the communication strategy, through the Action following consultation with end-users of the data to ensure outputs are in an accessible format.

Career development is an important ambition of the Action. For image-based insect AI to realise its potential, we need to grow the research capacity in Europe. This includes a need for career development amongst these researchers. The Action will address career development at three levels:

1.   supporting YRIs (Young Researchers and Innovators) to build their research skills and independence;
2.   giving YRIs leadership experience and
3.   providing established researchers the opportunity to support the careers of others.

The Action proposer network is rich in YRIs who will be represented in the leadership of all WGs within the Action. The training activities planned will offer chances for YRIs to learn the skills needed to use image-based insect AI technologies. This unique skill set will make these researchers more employable. By putting YRIs into leadership positions

within the Action, we will develop transferable skills for future leadership roles. Where activities target YRIs, we will additionally aim for a 50:50 gender representation.

Short-term Scientific Missions (STSMs) will provide opportunities for collaboration across the entire network and, at all career stages, however, will take steps to ensure inclusivity. The Action will prioritise applications from YRIs and work to a 50:50 gender representation across STSMs. Additionally, the action will favour applications from researchers in ITC countries seeking to spend their mission at centres of expertise elsewhere in Europe. Outputs, including blogs and posters, from the STSM will be available from the Action website. The Action will provide support to STSM applicants through feedback on proposals and reports. At each of the Action's annual conferences, the Action will run an 'STSM marketplace' where potential hosts of STSMs will give lightning talks about what they can offer and potential STSM applicants will be free to ask questions and develop ideas with hosts. Summaries of each host's lightning talk will also be placed on the Action's website for others to access.

Plan for dissemination and dialogue

The Action has many stakeholders, from researchers and innovators, policy-makers and non-governmental organisations, to industry and the general public. We will develop an adaptive dissemination plan and communication strategy in the first quarter of the Action. The Action will put in place a Communication Task-force and appoint a Communication Manager. The dissemination plan will ensure effective engagement with partners and opportunities for re-use of knowledge.

While some insects are considered to be popular with the **general public**, many are reviled despite the important ecosystem functions they perform and associated benefits to society (Losey and Vaughan 2006). The need to increase appreciation and understanding of the vital roles provided by insects has been widely recognised. Image-based insect AI technologies provide opportunities to engage the general public with insects. The Action will develop dissemination materials (postcards, posters, online infographics) in multiple languages to communicate the exciting technologies the Action is supporting, alongside engaging species accounts, focusing on their contributions to nature and people. Social media platforms will be used to share developments and outputs from the network including knowledge created through STSMs. The Action will also provide opportunities for face-to-face discussions at science festivals, citizen-science activities and other events across Europe, including BioBlitzes (events aimed at engaging the public in intense wildlife recording in a specific place over a short period of time, such as City Nature Challenge) and European Researcher's Nights.

Peer-reviewed scientific journals will be used to communicate outcomes relevant to **researchers, innovators and funding bodies**. The Action will mobilise resources to publish open-access methods papers to share knowledge created across the WGs. The Action will select journals to ensure global accessibility and high impact, including the journals published through entomological societies to increase visibility of the Action to entomologists. Peer-reviewed publications will be summarised through popular articles,

blogs, webinars and multilingual press releases as appropriate throughout the Action. All outputs will be promoted through the social media platforms and the Action website.

The Action will run activities that are innovative and impactful including design sprints with engineers and community groups, hackathons with computer scientists and entomologists and a 'BionicBlitz' bringing image collection and analysis technologies to the traditional 'BioBlitz'. **Guidance documents** for each of these activities will be published to aid others to replicate such events across Europe.

The Action will engage with relevant **local, national and global organisations** - including **policy-makers** and **NGOs** - who have a responsibility for monitoring insect biodiversity or whose activities impact on insect populations. This will include international organisations, such as IUCN and IPBES, as well as national bodies with responsibilities for forestry or farming. The Action will develop policy briefs in multiple languages to introduce image-based insect AI technologies and highlight advances, including creation of knowledge through the Action's diverse activities. The Action will encourage knowledge exchange with this community through quarterly on-line webinars including opportunities for discussion and suggestions for future topics of interest within the scope of the Action.

Exploitation of the Action's knowledge creation will be ensured through a programme of engagement with **industry**. The network of proposers has representation from Small and Medium-sized Enterprises (SMEs) that undertake environmental assessment, integrate AI into mobile apps and build in situ camera systems. Through these partners, the Action will identify trade shows and events where materials will be shared and research will be presented. In particular, the Action will promote the FAIR metadata standards developed with industry partners to aid data access and re-use.

All materials produced within the Action will be made available through a dedicated **website and social media platforms**. Content will include reports from workshops, conferences and STSMs, multilingual communication materials for stakeholders, training materials from Training Schools, recording of webinars, amongst other outputs. The Communication Task-force will coordinate this activity and ensure that content is up to date and inclusive at 6-monthly reviews of the communication strategy.
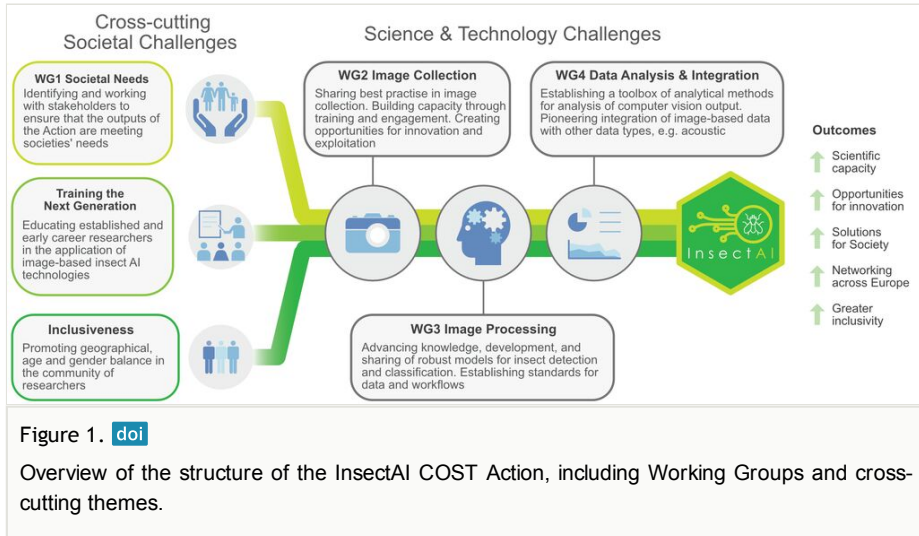
Implementation

InsectAI consists of four Working groups that will work together to deliver the ambitions of the action (Fig. 1).

Working Group 1: Societal Needs

WG 1 will focus on the needs of all stakeholders, using participatory approaches to ensure that the outputs of the technological advances (WGs 2-4) are relevant and benefit as many end-users as possible. The WG will collaboratively prioritise societal needs that will benefit from image-based insect AI technologies (WG2-4). The WG will guide the

development of dissemination resources to ensure effective transfer of knowledge between the Action and stakeholders.

Figure 1. doi

Overview of the structure of the InsectAI COST Action, including Working Groups and cross-cutting themes.

Objectives

1. **Engage with diverse stakeholders** to collaboratively document the key questions in insect research and monitoring, with specific focus on policy-needs and systematically prioritise those that could be addressed by imaged-based insect AI technologies in addressing the priority questions.
2. Increase understanding of the **needs of researchers and citizen scientists** for new tools and technologies within the context of the key questions derived in (1).
3. **Assess the benefits** of implementing tools and technologies to address the key questions derived in (1), while supporting increased engagement and uptake.
4. Ensure exploitation of technologies through **dissemination and communication** activities.

Working Group 2: Image Collection

WG 2 will focus on the collection of images of insects for processing using AI workflows. The WG will consider a range of methods and contexts in which insect images are collected, including field deployments of autonomous camera traps for insects, laboratory systems for bulk sample processing and mobile apps for aiding identification in the field. The WG will collaborate with other WGs to co-create metadata standards (WG3), survey designs (WG4), integrated approaches (e.g. combination with acoustics, WG4) and to identify priority research areas (WG1).

Objectives

1. Develop and share **best practices** for the application of hardware solutions, co-designed with stakeholders.

2. Build **research capacity**, through training and engagement, creating a community of practitioners with the skills and knowledge to use these technologies for research of national importance.
3. Create opportunities for **innovation and exploitation** of hardware for collecting images of insects in the field and in the laboratory.

Working Group 3: Image Processing

This WG will concentrate on topics relevant to the processing of images, in particular:

1. collecting and curating annotated training data for AI algorithms;
2. advancing algorithm development regarding robustness across technologies and dealing with rare species;
3. develop metadata standards for AI model outputs;
4. specifying infrastructure for running and sharing models, as well as storing reference images.

Objectives

1. **Establish standards** for storing and sharing data, for metadata of insect images and AI model outputs including standardised annotation formats and support for experts in the annotation process.
2. Alignment of **workflows and pipelines** across projects that use AI for insect recognition to allow easier exchange and exploitation of data and algorithms.
3. Advance knowledge, development and **sharing of robust models** for insect detection and classification that can be reused across projects and camera setups.

Working Group 4: Data Analysis and Integration

WG4 will address the downstream analysis of AI output. This will ensure that the Action can meet its key challenge to "understand … widespread insect declines" using these new technologies. The WG will focus on developing our understanding of the statistical methods needed to analyse these data, as well as how these data can be integrated with data on insects collected by traditional means and by other technologies, such as acoustics and radar. The WG will develop a range of workflows that will also give the inexperienced end-user ('trans-disciplinary individuals') the capability to interpret uncertainties in AI outputs, to apply rigorous statistical methods, based on the available data and to identify the best approach to integrate additional insect biodiversity data.

Objectives

1. Establishing a **toolbox of analytical methods** for analysis of AI output and for integrating traditional biodiversity data.
2. **Connecting researchers across technologies** (e.g. automated acoustic monitoring or radar), to develop methods for parallel deployment, data integration and to identify synergies and common challenges.

3.   **Train ecologists** in the interpretation and analysis of AI output.

Acknowledgements

Grant title

CA22129 - InsectAI - Using Image-based AI for Insect Monitoring & Conservation (InsectAI)

Hosting institution

UK Centre for Ecology and Hydrology

Conflicts of interest

The authors have declared that no competing interests exist.

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