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Review Paper on Smart Farming Using IOT and Blockchain Technology

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ABSTRACT:
Smartfarming,utilizingdigitaltechnologieslikeIoTandblockchain,cansignificantlyboostagriculturalproduction,sustainability, and efficiency. These technologiesprovide a secure, decentralized, and transparentplatformforcollectingandvalidatingagriculturaldata,offeringadvantageslikeenhancedsupplychaintraceabilityandautomatedagriculturalmanagement.

KEYWORDS: SmartFarming,IOTBlockchain,SensorNetworks,DataSecurity and Privacy

I. INTRODUCTION

The paper(1) explores the evolution of agriculturefromtheNeolithicRevolutiontomodernadvancements.Ithighlightstheshiftfromdomesticatingplantsandanimalstocultivatingcrops, leading to the rise of elites controlling landand food. The modern era sees the development ofDigitalAgriculture,leveragingadvancedtechnologieslikeIoT,blockchain,andwirelesssensor networks.The paper (2) defines” agriculture”isavitalpartofhumansociety,withmodern technologies improving monitoring of plant growth,diseases, and pest populations. Smart sensors andIoTareusedinagriculturetoaddressissueslikesoilconditions, weather, pest detection, and harvestingtime.Theyalsoofferreal-timesurveillanceoftemperature, humidity, pollution, water content, soilquality,andradiation.Smartfarmingenhancesprecision,promptdecision-making,andassistsfarmers in crop management.The paper(3) providesthatanumberofindustries,includingfarming andagriculture,havebeenprofoundlyinfluencedbysmart computing and the Internet of Things (IoT).These technologies provide a variety of functions,includingpesticidesprayingandreal-timecropcondition monitoring. These technologies, however,alsoexposefarmerstocybersecurityrisksand weaknesses, which might destabilize the economicsofnationswhereagricultureisamajorindustry.Thisworkoffersathoroughanalysisofprivacyandsecurityinthecontextofsmartfarming,withaparticular emphasis on a multi-layered architecturethat is pertinent to precision farming. It talks aboutpossible cyberattack scenarios, points out unsolvedresearch problems, and makes recommendations onhowtoproceedinthefuturetodealwiththeseproblems.

II. APPLICATIONS

Smart farming utilising IoT (Internet of Things) andblockchainsciencegivesarangeofadvantagessuch as greater efficiency, transparency, and traceabilityin agricultural operations. Here are a few real-worldexamples:

1. CropMonitoringandManagement:IoTsensorspositionedinfieldscanacquirestatisticsonsoilmoisture,temperature,humidity,anddifferentapplicable parameters. This facts is then analyzed tooptimizeirrigationschedules,noticenutrientdeficiencies,andforestalldiseases.Blockchainsciencecanbeusedtosecurelysavethisdata,making sure its integrity and permitting farmers togetentrytohistoricdataforhigherdecision-making.Forinstance,IBM'sFoodTrustplatform makesuseofblockchaintosongtheexperienceofmealsmerchandisefromfarmtoconsumer,offeringtransparency and making suremealssafety.reliability of predictive analytics by using securelystoringhistoricrecordsandfacilitatingstatisticssharing amongststakeholders.
2. Livestock Management: IoT gadgets such as RFIDtagsandsensorsareusedtorevealthehealth,behavior
3. andplaceoflivestock.Thisrecordshelps farmers in early disorder detection, optimizing

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feedmanagement, and enhancing breeding practices.
Byintegratingblockchain,aobviousandimmutablefileofeveryanimal'sfitnessandfoundationcanbemaintained, bettering have faith in the grant chain.Companies like Waltonchain are exploring the useof blockchain in cattle administration for improvedtraceability.

4. SupplyChainTraceability:Blockchaintechnologicalknow-howpermitsend-to-endtraceabilityinagriculturalprovidechains,fromfarmto fork. Each step of the manufacturing process,whichincludesplanting,harvesting,processing,anddistribution,canberecordedontheblockchain,supplyingbuyerswithdistinctrecordsaboutthebeginningandtripoftheirmealsproducts.Thistransparency helps in constructing client have faithand combating meals fraud. One excellent instanceis TE-FOOD, a blockchain-based meals traceabilityanswerusedinarangeofagriculturalsectorsglobally.
5. Smart Greenhouses: IoT sensors and actuators aredeployed in greenhouses to reveal and manipulateenvironmentalelementssuchastemperature,humidity, mild intensity, and CO2 levels. This real-time information permits farmers to create optimumdeveloping prerequisites for crops, main to greateryieldsandhigherbestproduce.Blockchain technologicalknow-howcanbebuilt-intofileenvironmentalrecordsandautomatetransactionsbetweenstakeholders,streamliningprovidechainmethods and making sure compliance with pleasantstandards.
6. Predictive Analytics: By leveraging IoT sensors andfactsanalytics,farmerscanpredictcropyields,disorderoutbreaks,andmostdesirableharvestinstancesgreateraccurately.Thispermitsforproactive decision-making and aid allocation, maintomultipliedproductivenessanddecreasedoperationalcosts.Blockchaincanbeautifythe reliability of predictive analytics by using securelystoringhistoricrecordsandfacilitatingstatisticssharing amongststakeholders.

III. METHODOLOGY

A. Concept:

IOTandsmartsensorsarerevolutionizingagriculture by enabling real-time data collectionand analysis for crop quality, soil health, waterlevels, and output. This technology is replacingtraditionalpractices,enablingsmartfarming, higheryields,andimprovedcropquality,soilhealth,erosion,fertilizerneeds,andfertilitystatus.Italsofacilitatesopticalirrigation,monitoring crop development, and high-qualityseed production. IOT and remote sensing datacanbeaccuratelyhandledforforestryandagriculture.
Thepaper(1)proposesablockchain-basedIOT-enabledsmartfarmingstrategy,enablingtransparentand secure data management. IOT devices track crophealth,gathergrowthdata,andusemachinelearningalgorithmsforinsights,enablingfarmerstoimprovecrop quality and irrigation systems. The differentkind of technology are used for smart farming. Inpaper(1) the usage of IoT sensors and software on avarietyofdevicestocreateatransparentandreliableagricultural product supply chain using blockchaintechnology isdiscuss.

TheresearchexploresIoTusageinagriculturalsupplychainmanagementandsmartfarming,focusing on key ideasrelated to thisfield:
•IoTtechnologycanbeusedtoconnectvariousdevicesandsensorsintheagriculturaldomaintocollectandexchangeinformation.ExamplesofIoTapplicationsin agricultureinclude:
•Sensorstomonitorsoilmoisture,humidity,temperature, crophealth, etc.
•Devicestocontrolirrigation,pesticideapplication,andotherfarmoperations.
•TrackinglivestockusingRFIDtags.
•Monitoringstorageconditionsinwarehousesandcold chains.
•The use of Internet of Things sensors anddevicescanenhanceagriculturalefficiencybyenablingcropproductionpredictions,resourceoptimization,earlydiseasedetection,andautomationofagricultural processes.
•The integration of IoT with big data analytics,cloudcomputing,andmobilecomputingcan create a smart agricultural ecosystem, enabling real-timeinformation sharinganddecision-making.
•Blockchain technology can enhancetransparency,traceability,andtrustintheagriculturalsupplychain.
•TheproposedIoTandblockchain-basedsmartfarmingmodelhasthreekeycomponents:
•IoTdevicesto collectfarmdata.
•Blockchaintostore,process,andsecurethedata
•Retail market platform to facilitate tradingofagricultural products.
•Thedocumenthighlightsthepotentialbenefitsofintegrating IoTwithblockchaininagriculture,includingimprovedfoodtraceability,increasedfarmerproductivity,

andfairpaymentsystems.

The paper(2) explains thechip-integrated sensorsare being used more and more in smart farming toassess crop production, monitor the environment,andharvestcropsautomatically.Microprocessorsprocess the precise environmental data that thesesensors record in order to analyze it. Smart farming,whichusesafewthousandtoseveralthousand nodesconnected to sensor hubs via a wireless and actuatornetworkdesign,isdependentontheInternetof Things.SmartsensorsareanessentialpartofInternet of Things systems since they allow for theremote monitoring of several parameters. These aredifferentkindof sensorsaregivenintable/

Table:Differenttypesofsensorsandtheirutility

Different type ofsensors	Utility	Working
Acoustic basedSensors	Detection andmonitoring ofPest population,harvesting offruits.	Measure alterationin noise level inagriculturalfields.
Electromagnetic Sensors	Recordelectromagneticresponses.	Accumulation ofelectric impulse insoil.
OpticalSensors	Employed tosense soiltexture,mineralscontent,moisture.	Changes in lightreflectance isassessed.
Electrochemical Sensors	Helps inmeasurement ofnutrient status andpHofsoil.	Individual sensorsrecordingElectrochemicalgradients inagriculturesoil.
AirflowSensors	Assesses soil-aircontent andpermeability; moisture contentand in mobile orstaticconditions.	It senses several soilproperties usingunique identifyingcharacteristics.

B. IntegrationofIOTdevices,farmsandhumannetworks:

Thepaper(2)discusstheintegrationofIoT devices,farms,andhumannetworksinvolvesconnectingsensorsanddevicesonfarmstocollectdata, analyze it, and make informed decisions.Thisdatacanincludeinformationaboutsoilmoisture, weather conditions, crop health, andequipmentperformance.ByleveragingIoTtechnology,farmerscanoptimizeresourceusage,increaseproductivity,andmakedata-drivendecisions. Human networks play a crucial role inthisintegrationbyprovidingexpertise,interpretationofdata,andcommunicationbetweenstakeholders,suchasfarmers,agronomists, and suppliers. This interconnectedsystem creates a more efficient and sustainableapproach to agriculture, benefiting both farmersand consumers. The flowchart of Integration ofIOT devices,farms and human networks is givenbebelow:

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FIG1Flowchart

The Exponential Gaussian Process Regression andCubistmodelsshowedexcellentperformancein soilmoisturecontentmaterialprediction.Theexponential regression could be used to model howsoil moisture changes over time or in response tocertainenvironmentalfactors(likerainfallortemperature).In soil moisture prediction, the Cubistmodelcouldbetrainedusingavarietyofinputfeaturessuchastemperature,precipitation,soiltype,vegetationcover,etc.,topredictsoilmoisturelevels.Itcanhandlecomplexinteractionsbetweenpredictorsandnonlinearrelationshipsbetweenvariables. .AnalgorithmusingHaarWaveletTransformandk-NNwasdevelopedtodisplayscreenweedswithhighereffectivenessandaccuracy. In smart farming, this could be used todetect abnormalities in crop growth, soil moisturelevels,temperaturevariations,etc.,which mayindicateissueslikepestinfestations,irrigationproblems,ordiseaseoutbreaks.Theframeworkslike CNNs and recurrent neural networks were used topredict crop yields, with CNN-RNN outperformingothermethods.AIhaspromisingpotentialtoenhanceIoTsinagriculture.

C. **SecurityandPrivacyinSmartfarming:**
The paper(3) explores security challenges in smartfarmingthatarespecificallyrelatedtoIoT(Internet ofThings)devicescanbenumerousandvaried.Here'san explanationofsomekeychallenges:

1. Device Vulnerabilities: IoT devices used in smartfarming, such as sensors, actuators, and monitoringsystems,areoftenresource-constrainedandmaylack built-in security features. These devices can besusceptible tovarious attacks, includingmalwareinfections,unauthorizedaccess,andmanipulation.
2. Data Privacy Risks: IoT devices collect vast amountsof data about farm operations, crop conditions, andenvironmental factors. Ensuring the privacy of thisdataiscrucial,asitmaycontainsensitiveinformation about crop yields, farming practices, oreven personal data of farmers. Unauthorized accesstothisdatacanleadtoprivacybreachesand misuse.
3. NetworkSecurity:IoTdevicesrelyonwirelesscommunicationnetworkstotransmitdatatocentralized systems or cloud platforms. However,these networks may not always be secure, makingthem vulnerable to interception, eavesdropping, andman-in-the-middleattacks. Securingcommunicationchannels between IoT devices and backend systemsisessentialtopreventdatatamperingorinterception.
4. AuthenticationandAccessControl:Managingaccess toIoT devicesand systems is criticalforpreventingunauthorizeduseortampering.WeakauthenticationmechanismsordefaultcredentialscanmakeloTdeviceseasytargetsforattackers.Implementingrobustauthenticationandaccesscontrolmechanisms,suchasmulti-factorauthentication and role-based access control, helpsmitigatetheriskofunauthorized access.
5. PhysicalSecurity:IoTdevicesdeployedinagriculturalsettingsareoftenexposedtoharshenvironmental conditions and physical tampering.Protectingthesedevicesfromphysical attacks,vandalism, or theft is essential for maintaining theintegrityofsmartfarmingsystems.Securemounting,tamper-resistantenclosures,andsurveillancemeasurescanhelpenhancethephysicalsecurityof IoT devices.
6. SupplyChainRisks:ThesupplychainforIoTdevices,includingcomponents,firmware,andsoftware,mayintroducesecurityvulnerabilitiesintosmartfarmingsystems.Counterfeitorcompromisedcomponents, insecure firmware updates, and supplychain attacks pose significant risks to the securityand reliability of IoT devices. Implementing supplychainsecuritymeasures,suchasvendorrisk

assessmentsandfirmwarevalidation,canhelpmitigatethese risks.

7. Lifecycle Management: Managing the lifecycle ofIoTdevices,includingprovisioning,deployment,maintenance,anddecommissioning,presentssecuritychallenges.Failuretoupdatefirmware,applysecuritypatches,orretireoutdateddevicescanleavesmartfarmingsystemsvulnerabletoexploitation.Implementingrobustdevicemanagementpractices,includingautomatedpatching,remotemonitoring,andsecuredecommissioningprocedures,helpsmaintainthesecurityofIoTdeploymentsthroughouttheirlifecycle.

D. Privacyconcerninsmartfarming:

Privacy concerns in smart farming revolve aroundthecollection,use,andsharingofsensitiveagricultural data. Here's an explanation of some keyprivacy concerns:

1. DataCollectionandSurveillance:Smartfarmingsystemsrelyon varioussensors,drones,satelliteimagery,andothermonitoringtechnologiestocollectdataaboutcropgrowth,soilconditions,weather patterns, and farm operations. While thisdataisvaluableforoptimizingagriculturalpractices,extensivedatacollectionraisesconcernsaboutsurveillanceandintrusiveness.Farmersmayfeeluneasy about constant monitoring of their activities,leading toprivacyimplications.
2. Personally Identifiable Information (PII) Protection:Agriculturaldatacollectedinsmartfarmingsystemsmayincludepersonallyidentifiableinformation(PII) about farmers, farm workers, or individualslivinginruralcommunities.Thiscouldincludenames,addresses,contactinformation,or otheridentifyingdetails.Protectingtheprivacyofthisinformationiscrucialtopreventunauthorizedaccess,identity theft, ormisuse.
3. Data Ownership and Control: Clarifying ownershipandcontrolofagriculturaldataisessentialforaddressingprivacyconcernsinsmartfarming.Farmers may worry about losing control over theirdatawhenusingthird-partyplatformsorservicesfordata collection and analysis. Ambiguities regardingdata ownership and control can lead to mistrust andreluctanceto adoptsmartfarming technologies.
4. DataSharingandAggregation:Smartfarmingsystems often involve sharing agricultural data withvariousstakeholders,includingagriculturalresearchers,agribusinesses,governmentagencies, and insurance companies. While data sharing canfacilitate collaboration and innovation, it also raisesprivacy concerns. Farmers may be hesitant to sharesensitive data due to concerns about how it will beused, who will have access to it, and whether theirprivacyrightswillbe respected.
5. Regulatory Compliance: Compliance with privacyregulations,suchastheGeneralDataProtectionRegulation (GDPR) in the European Union or theCalifornia ConsumerPrivacy Act (CCPA) intheUnitedStates,isessentialforsmartfarmingdeployments.Failuretocomplywiththeseregulations can result in legal liabilities, fines, andreputational damage. Ensuring that smart farmingsystemsadheretoapplicableprivacylaws andregulations is critical for protecting farmers' privacyrights.
6. DataSecurityBreaches:Datasecuritybreachesposeasignificantprivacyriskinsmartfarming.Unauthorized access to agricultural data, whetherthrough cyberattacks, insider threats, or accidentaldisclosure,canresultinprivacyviolationsandfinancial losses. Protecting agricultural data againstsecuritybreachesrequiresimplementingrobustsecuritymeasures,suchasencryption,accesscontrols,anddatabreachdetection system.

IV. CONCLUSION

In Conclusion, the synthesis of these three papersunderscorestheInternetofThings(IoT)andblockchaintechnologiesarerevolutionizingagricultural practices by addressing challenges suchas pest control, security, and privacy. By deployingsensornetworks,precisionagriculturetechniques, and data analytics, farmers can optimize resourceallocation,enhancecropyield,andmitigateenvironmentalimpact.Blockchaintechnologyofferssecure and transparent data management solutions,ensuring the integrity, authenticity, and traceabilityofagriculturaldata.IoTsensorsplayacrucialroleinpestmonitoring,detection,andcontrol,allowingfarmers to implement targeted interventions, reducepesticideusage,andminimizecroplosses.However,robustsecuritymeasuresareneededtoprotectagriculturaldataandinfrastructurefromcyber-physical threats, data breaches, andsupplychainvulnerabilities. Privacy concerns surrounding datacollection, sharing, and ownershipemphasize theimportance of transparency, consent, and regulatorycomplianceinsmartfarmingoperations.Blockchaintechnologyoffersadecentralizedplatformforsecuringagriculturaldata,enhancingtrust,accountabili ty,andtraceabilityacrosstheagriculturalvaluechain.Collaborationamongresearchers,industrystakeholders,policymakers,and farming communities is essential for realizingthefullpotentialofsmartfarming.

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Paper(2)
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By:PremRajak,AbhratanuGanguly,SatadalAdhikary,Suchandra Bhattacharya

Paper(3)
SecurityandPrivacyinSmartFarming:Challengesand Opportunities
By:Manak Gupta, Sudip Mittal,MahmoudAbdelsalam