Program Profile		
Program	Program name	IoT-based Livestock Health Monitoring System with Real-Time Location Tracking
	Category	A3

Summary of Program	
Program Name	IoT-based Livestock Health Monitoring System with Real-Time Location Tracking
Category	A3
Abstract of Program	The IoT-based Livestock Health Monitoring System with Real-Time Location Tracking presents a transformative approach to managing livestock by leveraging advanced technologies like the Internet of Things (IoT), machine learning, GPS, and cloud computing. This system aims to address critical challenges in modern livestock management, such as disease outbreaks, theft, inefficient resource allocation, and animal welfare concerns. The system provides continuous monitoring of vital health parameters, such as body temperature, heart rate, and movement patterns, while also integrating real-time location tracking to prevent livestock loss. By combining wearable sensors, cloud storage, and predictive analytics, the system enables proactive intervention and data-driven decision-making. The system's scalability and flexibility make it applicable for farms of various sizes, particularly in remote and rural areas where traditional methods often fall short. This project aims to revolutionize livestock management by increasing productivity, ensuring animal welfare, reducing operational costs, and contributing to the broader goal of sustainable agriculture.

Details of Program		
Planning		
Objectives	Long-term Goals	The IoT-based Livestock Health Monitoring System aims to revolutionize livestock management over the next several years through the integration of advanced technologies like IoT, machine learning, and cloud computing. The long-term objectives include: • **Global Expansion (2025-2030)**: Over the next five years, the system will be expanded to large-scale commercial farms worldwide, starting with key agricultural regions. The goal is to ensure the system benefits not just local farms but also contributes to the global movement towards smarter, more efficient agriculture by 2030. • **Continuous Technological Advancements (2025-2035)**: By 2035, the system will undergo continuous improvements, including advancements in machine learning algorithms for more precise health predictions, optimized communication protocols for rural areas, and the integration of blockchain technology to ensure data integrity. These upgrades will position the system as a cutting-edge tool in modern livestock

		management. • **Sustainability Integration (2025-2035)**: The system will integrate sustainability practices into its operations, aiming to reduce resource consumption and promote animal welfare. By 2030, the program will contribute to the global goals of sustainable farming and food security, with the system evolving into a key solution for eco-friendly agriculture. • **Collaboration with Government Policies (2026-2030)**: Between 2026 and 2030, we aim to work closely with government bodies worldwide to influence smart farming policies and secure incentives for farmers adopting IoT-based solutions. This collaboration will help shape future regulations and support the widespread use of technology in agriculture. • **Training and Education Programs (2025-2030)**: A key objective will be to establish comprehensive training programs for farmers, agricultural workers, and students by 2025. By 2030, we aim to have trained over 5,000 individuals globally in IoT-based livestock management, ensuring the adoption of technology and building a skilled workforce for the future. • **Scaling to Different Livestock Types (2026-2035)**: The system will be adapted to support different livestock species by 2026, with a broader rollout across various agricultural sectors. By 2035, it will be scalable for diverse farm types globally, ensuring that the solution is adaptable to meet the needs of farmers of all sizes and regions.
	Short-term Targets	• **Pilot Testing and Validation (Q1-Q2 2025)**: Conduct pilot testing of the IoT-based Livestock Health Monitoring System with at least 10 local farms in rural Bangladesh. The goal is to collect initial feedback, fine-tune the system, and ensure that all sensors, GPS modules, and cloud computing platforms are functioning as expected. • **System Optimization and Calibration (Q2 2025)**: Optimize the system's performance based on feedback from the pilot test. This includes calibrating the sensors for more accurate health data and addressing any connectivity issues in remote areas by introducing hybrid communication technologies (e.g., LoRaWAN and NB-IoT). • **Training and Support Program (Q2 2025)**: Develop and launch a comprehensive training program for farmers and farm managers on how to use the IoT-based system effectively. This program will include online tutorials, on-site training sessions, and a user manual to ensure smooth adoption. • **Monitoring and Data Collection (Q2-Q3 2025)**: Continuously monitor the system's performance and collect data on animal health, location tracking, and user experience. This data will be used for

		further system refinements and to showcase the program’s impact in reducing mortality rates, improving productivity, and preventing theft. • **Partnership Development (Q3 2025)**: Establish partnerships with local government agencies, agricultural organizations, and tech companies to support the wider adoption of the system. This will include seeking government incentives for smart farming solutions and securing collaborations with universities for further research. • **Initial Expansion to Additional Farms (Q4 2025)**: Expand the system to 20 additional farms, with a focus on improving the scalability and robustness of the system. The aim is to reach a broader base of users, collect more comprehensive data, and prepare for a larger rollout in 2026. • **Monitoring Program Outcomes (Q4 2025)**: Begin evaluating the outcomes of the pilot testing and early adoption phase, including key performance indicators such as reduced livestock mortality, theft prevention, and overall farm productivity. Prepare a report detailing these outcomes for future stakeholders.
	Rationale	The **IoT-based Livestock Health Monitoring System** was initiated to address critical challenges in livestock management, including disease outbreaks, theft, inefficient resource use, and the lack of real-time data. Traditional methods often lead to delayed interventions and operational losses. By leveraging IoT, machine learning, GPS, and cloud computing, the system enables continuous monitoring of animal health, early disease detection, theft prevention, and optimized resource management. This not only improves animal welfare and productivity but also promotes sustainability by reducing waste and resource inefficiencies. Additionally, the system empowers farmers with data-driven decision-making, ensuring better farm management and profitability, particularly in rural areas where technology adoption has been limited. Overall, the program aims to modernize livestock management, enhance food security, and contribute to more sustainable and efficient farming practices.
Subject (Leader)	Initiator(s)	Hossain, Mohammad Anwar
	Champion(s)	Hossain, Mohammad Anwar
	Major team member(s)	ARNOB CHAKRABORTY, AROJUN PAUL, MD. IMRAN HOSSAIN, Noshin Un Noor, MD. MINHAJUL ISLAM, MD. SHAHADAT HOSSAIN SHISHIR, Shamsun Nahar
Environment	Nature/Society	The IoT-based livestock health monitoring system is designed to address challenges faced by rural and agricultural communities. These communities rely on livestock for food, income, and cultural practices but face issues like disease outbreaks, theft, and inefficient management. The system provides real-time monitoring of animal health and location, enhancing

		sustainability, reducing losses, and supporting food security, benefiting both farmers and society.
	Industry/Market	The livestock farming industry is increasingly adopting technology to improve productivity and manage challenges like disease, theft, and resource inefficiency. The IoT system is a key innovation in this transition, offering scalability for both large commercial farms and small family-owned operations. As the market for smart farming grows, this solution positions itself as essential for modernizing livestock management and improving farm profitability.
	Citizen/Government	Governments are actively promoting smart farming technologies to ensure food security, animal welfare, and environmental sustainability. IoT solutions in livestock management align with these goals by improving disease prevention and farm efficiency. Governments can support adoption through incentives and use the data for policymaking, enhancing the overall livestock sector's resilience and sustainability.
Resources	Human resources	The study requires- - 6 undergraduate students (design, prototyping, testing) - 3 faculty supervisors - 10 local farmers (pilot testing, feedback)
	Financial resources	Budget: ~$3000 (sensors, microcontrollers, GSM module, gateway, solar panel, remuneration for students, supervisors and farmers).
	Technological resources	• IoT sensors (temperature, heart rate, and movement sensors). • GPS modules for real-time location tracking. • Low-power communication protocols like LoRaWAN and NB-IoT for data transmission. • Cloud computing platforms (e.g., ThingSpeak) for data storage and analytics. Machine learning algorithms for disease prediction and anomaly detection.
Mechanism	Strategy (Weight/Sequence)	The IoT-based livestock health monitoring system offers three primary strategic options: first, IoT Sensor Integration, which involves equipping livestock with sensors to continuously monitor vital health parameters and track their location in real-time. This provides the foundation for accurate data collection. Second, Cloud-Based Data Storage and Analytics enables the centralized processing, storage, and analysis of the collected data, offering farmers remote access to insights and enhancing decision-making capabilities. Third, Real-Time Alerts with Machine Learning uses predictive algorithms to detect potential health issues early, sending immediate notifications to farmers for swift intervention, thereby improving animal welfare and preventing losses.
	Organization	The organizational structure of the World University of Bangladesh (WUB) is well-aligned with the IoT-based Livestock Health Monitoring System's strategies. The university's focus on innovation, research, and technology, particularly through the Department of Computer Science & Engineering, provides the necessary expertise to develop and implement the system. Strong leadership support from the Vice Chancellor and Vice President ensures adequate resources and administrative backing. The university’s culture of applied learning, along with its partnerships with agricultural and governmental bodies, facilitates the program’s scalability and sustainability, ensuring effective implementation and long-term success.
	Culture	The culture at the **World University of Bangladesh (WUB)** strongly supports the execution of the **IoT-based Livestock Health Monitoring System**. The university fosters a culture of innovation, research, and

		practical application of technology, which aligns well with the program's objectives. Faculty and students are encouraged to engage in hands-on projects, bridging theoretical knowledge with real-world impact. WUB's emphasis on interdisciplinary collaboration and its commitment to advancing technological solutions for societal challenges create an ideal environment for the program. Additionally, the university values sustainability and community engagement, which aligns with the program's goals of improving agricultural practices and promoting food security. Overall, the university's culture is conducive to the successful development, implementation, and scaling of this innovative project.
Doing		
Launch date		January 2025
Responsible organization		World University of Bangladesh
Program content and process		The **IoT-based Livestock Health Monitoring System with Real-Time Location Tracking** integrates advanced digital technologies into traditional livestock management to address pressing challenges such as disease outbreaks, theft, and inefficient resource utilization. The program content is built around three interconnected layers: 1. **IoT Sensor Integration:** Wearable devices equipped with temperature, heart rate, and motion sensors are attached to livestock to collect real-time physiological and behavioral data. GPS modules provide continuous location tracking, ensuring both health and security. 2. **Cloud-Based Analytics:** Data collected by sensors is transmitted through low-power communication protocols (LoRaWAN, NB-IoT) to cloud platforms for secure storage and processing. A web dashboard and mobile app allow farmers and researchers to remotely access real-time insights. 3. **Machine Learning and Alerts:** Predictive algorithms analyze patterns to detect early signs of illness, stress, or abnormal behavior. Automated alerts are sent to farmers via SMS or mobile notifications, enabling timely intervention and reducing risks of mortality or loss. The implementation process follows a structured pathway: • **Design and Development:** Faculty members and undergraduate students in the Department of CSE collaboratively design sensor circuits, develop software modules, and prototype devices. • **Pilot Testing:** Small-scale trials are conducted in collaboration with local farmers to calibrate sensors, validate data accuracy, and gather user feedback. • **Training and Capacity Building:** Farmers receive hands-on training to operate the system, while students gain practical experience in IoT, cloud computing, and AI applications. • **Scaling and Refinement:** Insights from pilot tests are used to improve hardware reliability, optimize energy efficiency through

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<tr><td></td><td>solar-powered modules, and enhance predictive models.</td></tr>
<tr><td>Key highlights of the content/process</td><td>
Key Highlights of Content

Real-Time Monitoring: Continuous tracking of livestock health (temperature, heart rate, movement) and GPS-based location to reduce mortality and theft.
Data-Driven Insights: Cloud-based storage and machine learning analytics enable predictive health management and early intervention.
Scalable & Sustainable Solution: Designed to support both small family farms and large commercial operations with energy-efficient and low-cost IoT devices.

Key Highlights of Process

Student-Centered Development: Undergraduate students and faculty collaboratively design, prototype, and test the system, bridging theory with real-world application.
Farmer Collaboration: Pilot testing and feedback from local farmers ensure practical usability and direct community impact.
Iterative Implementation: Stepwise approach—design, testing, training, and scaling—ensures reliability, adoption, and long-term sustainability.

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<tr><td>Differences from traditional approaches</td><td>
Before Implementation (Traditional Approaches):

Livestock health monitoring depended on manual observation by farmers, which was time-consuming, inconsistent, and often failed to detect early symptoms of disease.
Records of animal health and productivity were kept manually, leading to errors, loss of data, and lack of real-time insights.
Theft prevention relied on physical supervision, with little to no technological support, making recovery of lost or stolen livestock extremely difficult.
Decision-making was reactive, with interventions occurring only after visible problems emerged, often resulting in higher veterinary costs, livestock mortality, and reduced productivity.

After Implementation (IoT-Based System):

Livestock are equipped with wearable IoT sensors that continuously track health parameters and GPS location, enabling real-time monitoring and automated data collection.
Data is transmitted to the cloud platform, ensuring secure, accurate, and easily accessible records that support long-term planning and analytics.
Predictive analytics and alerts allow early detection of diseases or

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	abnormal behavior, enabling proactive veterinary care and reducing losses. • **GPS tracking** provides theft protection by offering real-time location updates, improving herd management and ensuring greater security. • Farmers and students can access **mobile dashboards and apps** for decision-making, improving efficiency and reducing reliance on manual inspections.
Progress as of today	The project has made significant progress toward its implementation goals, combining both technical development and stakeholder engagement: • **System Design and Prototyping:** The hardware architecture has been designed, including temperature, heart rate, and motion sensors integrated with GPS modules. Initial prototypes have been developed and tested in controlled environments to ensure accurate data collection. • **Software Development:** A cloud-based data storage system using IoT platforms (e.g., ThingSpeak) has been set up, along with a preliminary dashboard for real-time monitoring. Mobile notification and alert functions are under development. • **Student Involvement:** Six undergraduate students, under faculty supervision, have contributed to circuit design, coding, and prototype testing. This has provided valuable hands-on learning in IoT and AI applications. • **Pilot Preparation:** Collaboration has been established with local farmers to conduct small-scale trials. Farmers have been briefed on the system's functionality, and sites for pilot testing have been identified. • **Resource Mobilization:** Basic funding and necessary components (sensors, GSM modules, microcontrollers) have been secured, while procurement of additional equipment is in process. While key milestones such as prototype creation, software integration, and stakeholder engagement have been achieved, the **field-level pilot testing and large-scale validation** are scheduled to begin by early 2025. The project is on track, with approximately **50–60% of preparatory and development work completed**.
Problems in implementation	• Connectivity issues: Rural areas may lack reliable network infrastructure, hindering data transmission. • Sensor calibration: Accurate data requires regular calibration of sensors, especially in harsh environmental conditions. • Adoption challenges: Farmers may resist new technologies due to cost or lack of familiarity.
Approaches to solve the problems	• Hybrid Communication: Implementing hybrid communication technologies (LoRa, satellite, NB-IoT) to address connectivity issues in remote areas. • Energy-efficient solutions: Using low-power sensors and solar-

	powered devices to minimize the need for frequent battery changes. • Training and Support: Offering training programs to farmers and providing technical support to ensure smooth adoption.
Completion date, if completed	
Seeing	
Impacts on students	Students involved in this project will gain hands-on experience in IoT technologies, machine learning, and cloud computing. The project also provides an opportunity to explore real-world applications of these technologies in agriculture and contribute to the development of sustainable farming practices.
Impacts on professors	Professors will benefit from the practical application of their research in IoT and data analytics. The university will enhance its reputation for contributing to the advancement of technology in agriculture, potentially leading to collaborations with industry and further research opportunities.
Impacts on university administration	The university administration, including the Vice-Chancellor and senior leadership, has expressed strong satisfaction with the outcomes of the IoT-based Livestock Health Monitoring System, recognizing it as a flagship initiative that positions World University of Bangladesh as a forward-thinking institution addressing national and global challenges. Administrators value the project's ability to extend impact beyond the classroom by delivering technology-driven solutions for society while also strengthening the university's reputation in research, student engagement, and industry collaboration. They are particularly pleased with the strong involvement of students, as it reflects WUB's commitment to experiential learning and skill development. Overall, the administration views the program as a strategic success that enhances institutional prestige, creates pathways for partnerships, and reinforces the university's identity as an innovation-driven and socially responsible institution.
Responses from industry/market	Industry stakeholders in Bangladesh's livestock sector have responded positively to the IoT-based Livestock Health Monitoring System, recognizing its potential to reduce losses from disease and theft while improving overall farm productivity. Farmers and small-scale livestock owners have shown particular interest in the program during preliminary discussions, noting that real-time monitoring and predictive alerts could significantly lower veterinary costs and improve herd management. Larger agribusinesses and dairy producers see the system as a cost-effective way to modernize operations and enhance efficiency, aligning with their ongoing efforts to adopt smart farming practices. The industry views the program as a timely and innovative solution that directly addresses pressing challenges in livestock management, and early feedback indicates a strong willingness to collaborate on pilot testing and eventual adoption.
Responses from citizen/government	Local citizens, particularly livestock-dependent farmers in rural communities, have expressed strong interest in the program, as it directly addresses their concerns about animal health, theft, and economic losses. They recognize that early disease detection, real-time location tracking, and reduced veterinary costs can improve both household income and food security. The government has also shown favorable responses, as the program aligns with national priorities on sustainable agriculture, food safety, and the adoption of smart farming technologies. Officials see potential for scaling the system to support rural development, reduce

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<tr><td></td><td>poverty, and strengthen resilience in the agricultural sector. Overall, both citizens and government stakeholders view the program as a practical, socially responsible, and forward-looking initiative that can enhance livestock management and contribute to national food security goals.</td></tr>
<tr><td>Measurable output (revenues)</td><td>The IoT-based Livestock Health Monitoring System with Real-Time Location Tracking delivers several measurable financial and operational benefits. These can be expressed in revenue and cost-savings terms as follows:

1. Reduction in Livestock Mortality Rates
o Early disease detection lowers mortality by up to 10%, translating into significant savings on replacement costs.
o For a farm with 100 cattle valued at $500 each, preventing the loss of 10 animals saves $5,000 annually.
2. Decrease in Livestock Theft
o Real-time GPS tracking reduces theft-related losses.
o On average, preventing 2–3 stolen animals per year at $500 per head secures $1,000–$1,500 annually.
3. Improved Productivity and Efficiency
o Healthier livestock increases milk, meat, and reproduction output by 5–10%.
o A farm producing $50,000 annually in livestock products could generate an additional $2,500–$5,000 annually.
4. Cost Reduction in Veterinary Expenses
o Early detection reduces the need for expensive treatments by 15–20%.
o If a farm spends $4,000 yearly on veterinary care, savings of $600–$800 annually are achievable.
5. Operational Savings
o Remote monitoring and optimized labor reduce inspection and resource costs.
o Estimated annual savings in labor and feed efficiency: $1,000–$2,000.
6. Return on Investment (ROI)
o Initial setup cost: ~$3,000.
o Combined yearly benefits (mortality reduction, theft prevention, productivity gains, veterinary savings, labor savings) can total $10,000–$14,000 annually, achieving ROI in 1–3 years.</td></tr>
<tr><td>Measurable input (expenses)</td><td>Measurable Input (Expenses)

The implementation of the IoT-based Livestock Health Monitoring System with Real-Time Location Tracking requires specific financial inputs. The expenses can be categorized as follows:

1. Initial Setup Costs
o IoT Sensors & Devices (temperature, heart rate, GPS, movement sensors, GSM modules): $1,200
o Microcontrollers & Gateways (LoRa/NB-IoT modules,</td></tr>
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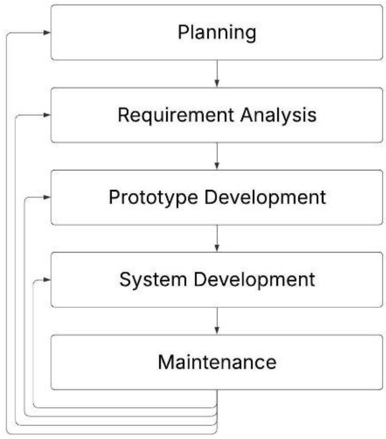
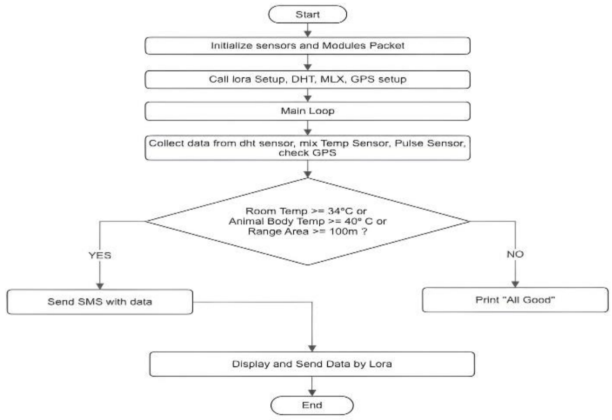
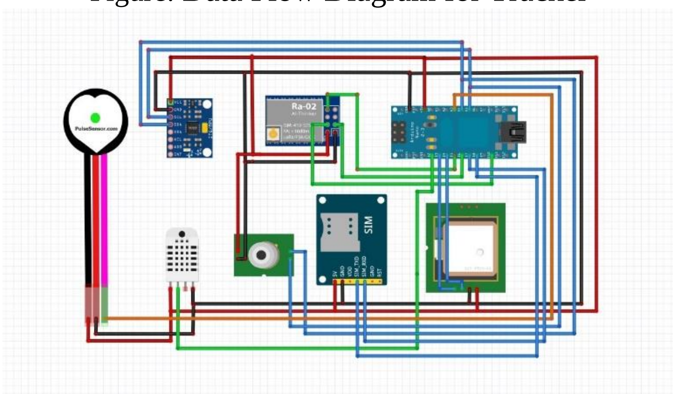
	solar-powered gateways): $600 o Cloud Infrastructure (setup for ThingSpeak or equivalent platform, storage, dashboard development): $500 o Software Development & Customization (dashboards, machine learning integration): $400 o Training & Workshops for Farmers and Students: $300 Subtotal (Initial Setup): ~$3,000 2. Operational Costs (Annual) o Maintenance & Calibration of Sensors: $200–300/year o Cloud Subscription Fees: $150–200/year o Energy Costs (solar panels, backup power, batteries): $100–150/year o System Updates & Technical Support: $200/year Subtotal (Operational): ~$650–850 per year 3. Human Resource Inputs o Student Remuneration (6 students, prototyping & testing): included in setup (~$300) o Faculty Supervisors (3 professors): in-kind contribution (guidance & supervision valued at ~$1,000) o Local Farmers (10 for pilot testing): compensation & incentives (~$500) Subtotal (Human Resources): ~$1,500 (mostly in-kind and partial cash inputs)
Cost-benefit analysis for effectiveness	**Costs:** 1. Initial Setup Costs: o IoT Sensors & Devices: Cost of purchasing and installing sensors (temperature, heart rate, GPS) and supporting infrastructure. o Cloud Infrastructure: Setup and maintenance costs for cloud storage and analytics. o Software Development: Customization of the system's software, including dashboards and machine learning. o Training & Support: Staff training and ongoing technical support. 2. Ongoing Operational Costs: o Maintenance & Calibration: Regular upkeep of sensors and equipment. o Cloud Subscription Fees: Recurring costs for data storage and processing. o Power Supply Costs: Energy expenses, especially in remote areas. o System Updates: Software updates and technical support. **Benefits:** • Reduction in Livestock Mortality Rates: Early health issue

	detection can reduce mortality rates by 10%, saving on replacement costs and increasing productivity. • Decreased Livestock Theft: GPS tracking helps recover stolen animals, preventing losses from theft. • Improved Productivity: Healthier livestock leads to a 5-10% increase in productivity (milk, meat, reproduction). • Lower Veterinary Costs: Early detection reduces the need for expensive treatments, cutting healthcare costs by 15-20%. • Operational Savings: Remote monitoring reduces manual inspections and optimizes resource use, lowering labor and resource costs. • ROI: The system achieves ROI within 1-3 years, driven by increased productivity and reduced costs.
Future Planning	
Where does the project go from here?	The next steps for the IoT-based livestock health monitoring system focus on scaling the technology and enhancing its capabilities. • Expansion to Larger Farms and Diverse Livestock: The system will be adapted to support a wider variety of livestock types and larger-scale farms, allowing it to cater to both small family-owned farms and large commercial operations. • Integration of Advanced AI and Machine Learning: Future developments will include integrating more advanced AI and machine learning models for even more accurate predictive analytics, improving the system's ability to identify health risks and optimize herd management. • Improved Connectivity Solutions: Addressing connectivity challenges in remote areas by integrating hybrid communication solutions, such as combining LoRa with satellite or cellular networks, will ensure the system functions reliably even in areas with poor infrastructure. • Blockchain for Data Security: Blockchain technology may be implemented to enhance data security, providing tamper-proof records of health, movement, and breeding data, which can improve transparency and trust within the supply chain. • Global Adoption and Market Expansion: The system will be marketed globally, focusing on regions with growing livestock industries, where the technology can have the greatest impact on productivity, animal welfare, and sustainability. • Collaboration with Industry Partners and Governments: The project will seek further collaboration with industry stakeholders, agricultural agencies, and governments to promote the adoption of smart farming technologies, align with regulatory standards, and provide farmers with necessary resources or incentives. By addressing these developments, the project will continue to evolve and establish itself as a critical tool for modernizing livestock management and advancing sustainable agriculture practices worldwide.
Addendum	

Exhibits, pictures, diagrams, etc.	 Figure: Proposed Model Methodology  Figure: Data Flow Diagram for Tracker  Figure: Circuit diagram for Tracker

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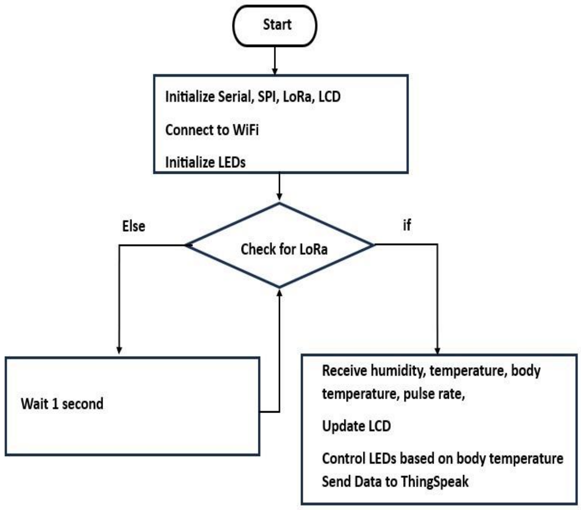
<tr><td></td><td>

Figure: Data Flow Diagram for Hub Station

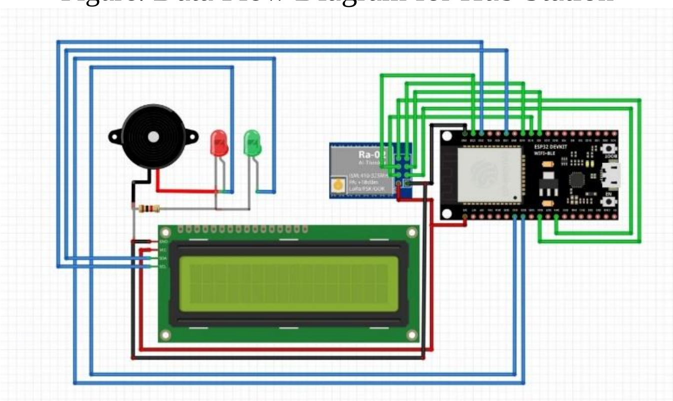



Figure: Circuit diagram for Hub Station</td></tr>
<tr><td>Reports, mimeos, monographs, books, etc.</td><td></td></tr>
<tr><td>Others which may help explain the program (including website links)</td><td></td></tr>
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