MANAGING FIRE: INCREASING COMMUNITY-BASED FIRE MANAGEMENT OPPORTUNITIES

Date 7 oct 2023

MEET THE TEAM

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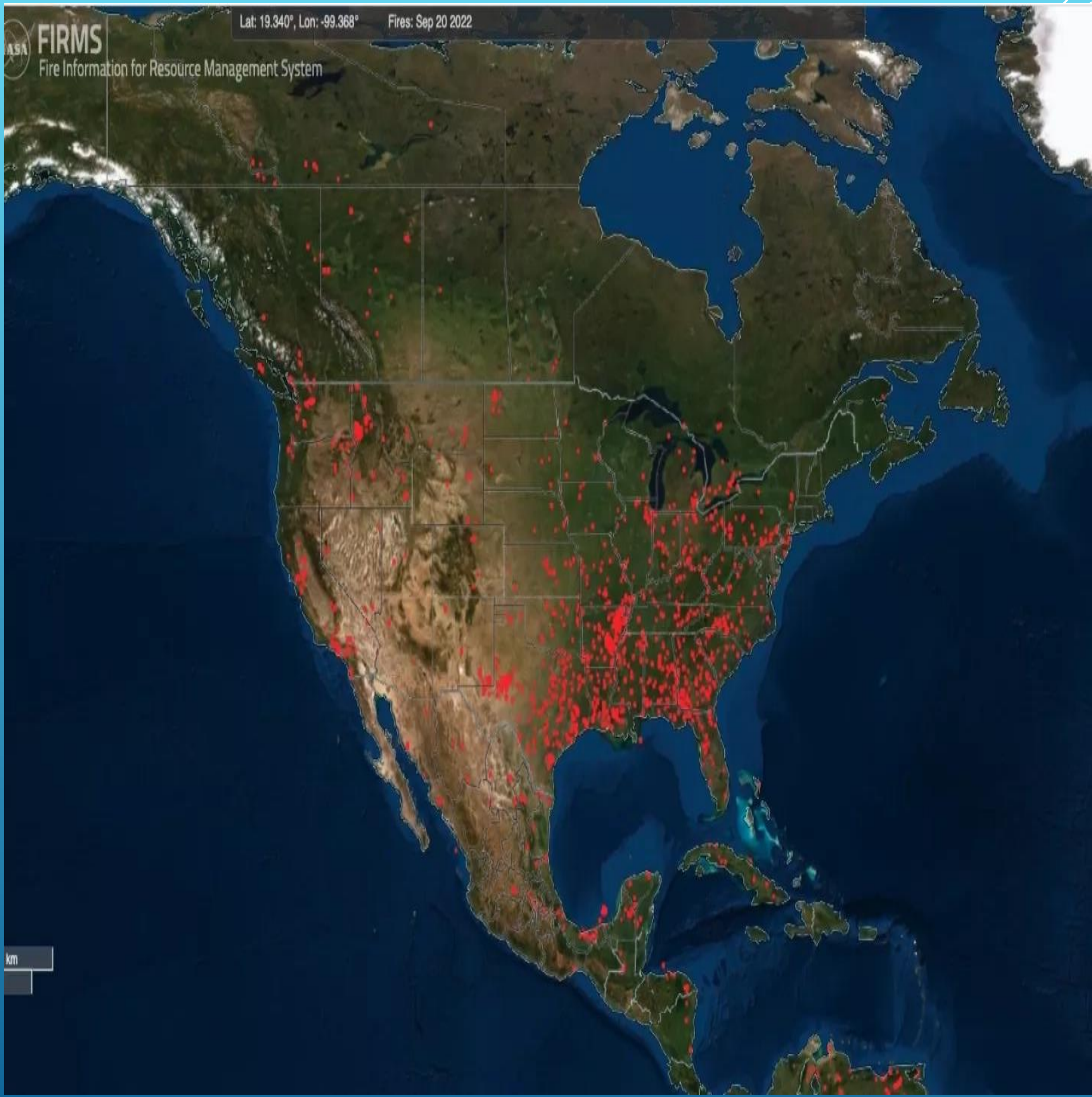
We are **Dr. Ahmed Mateen Buttar, Sadaf Naz** and **Ruqya Bashir**, a dynamic team committed to tackling one of the most significant challenges facing our world right now. Our motivation for taking part in the NASA Space App Challenge stems from our interest in space technology and its potential to improve community-based fire management capabilities.

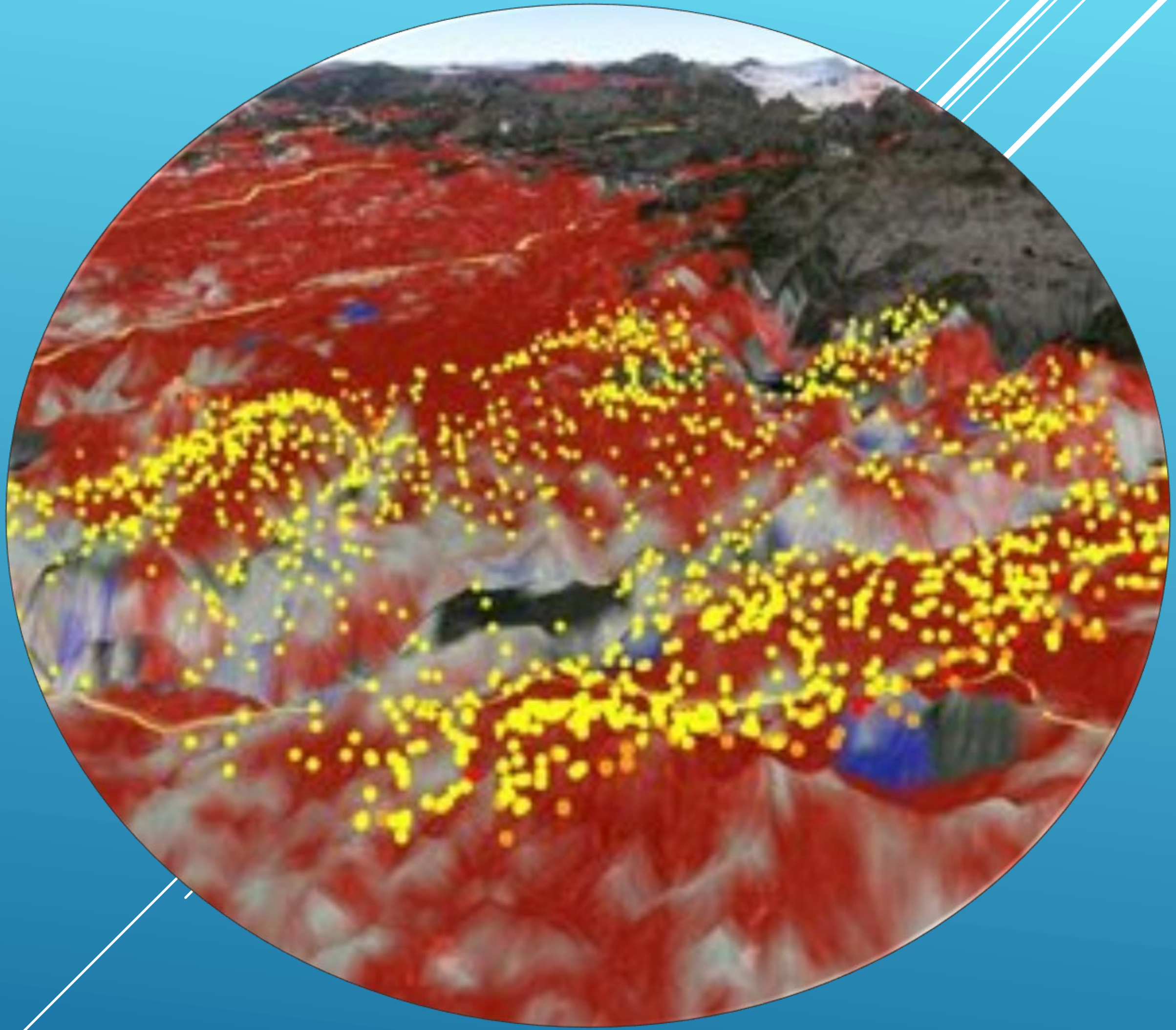
FIRE MANAGEMENT

Fire management seeks to strike a balance between the ecological importance of fire in certain ecosystems and the need to protect human communities and infrastructure. It involves a combination of proactive measures to prevent wildfires, readiness and response measures when fires occur, and post-fire activities aimed at recovery and restoration.



PROBLEM STATEMENT

Wildfires pose a significant threat to both human lives and ecosystems, and effective fire management strategies are essential to mitigate their impact. One potential approach is community-based fire management, where local communities actively participate in wildfire prevention, control, and recovery efforts. However, despite some existing research on this topic, there remains a critical gap in our understanding of the effectiveness of community-based fire management and its potential for broader adoption.



IMPORTANCE OF FIRE MANAGEMENT AND ITS IMPACT ON COMMUNITIES

- Protection of Lives and Property
- Preservation of Ecosystems
- Air Quality and Health
- Economic Impact
- Climate Change

NASA CHALLENGE AND ITS GOALS:

The NASA challenge is an initiative aimed at harnessing technology, data, and community involvement to enhance fire management. Its goals typically include:

Innovation

Data Utilization

Community Involvement

Resilience Building

OBJECTIVES:

1. To assess the current state of community-based fire management initiatives in the target region.
2. To identify the key challenges and opportunities in implementing community-based fire management.

COMMUNITY-BASED FIRE MANAGEMENT:

Community-based fire management is an approach to wildfire prevention, preparedness, and response that actively involves local communities in the planning and execution of fire management strategies.

ADVANTAGES OF COMMUNITY-BASED FIRE MANAGEMENT

Local Knowledge and Expertise

- Intimate knowledge of local landscapes, weather patterns, and historical fire behavior.
- Traditional or indigenous fire management practices.

Early Detection and Rapid Response

- Quick response reduces the size and impact of wildfires.
- Protects lives, property, and critical ecosystems.

Reduced Fire Risk

- Community-based actions lower the risk of wildfires.
- Activities like controlled burns, fuel reduction, and firebreak creation.
- Decreases the accumulation of flammable vegetation.

Cont.

Cost Saving

- Community involvement can lead to cost savings.
- Utilization of local resources.
- Cost-sharing among community members.

Customized Solutions

- Tailored solutions for specific community needs.
- Adaptation to local conditions.
- Context-specific strategies.

Environmental Benefits

- Community-based fire management has ecological benefits.
- Restoration of ecosystems.
- Promotion of biodiversity.

NASA'S ROLE

NASA plays a significant role in fire management and technology through its expertise in satellite technology, remote sensing, data analysis, and research.

- Data Analysis and Modeling
- Fire Detection and Monitoring
- Fire Emission Tracking
- Air Quality Monitoring
- Fire Weather and Climate Research

HOW TECHNOLOGY AND DATA AID IN FIRE MANAGEMENT:

Technology and data play a critical role in modern fire management by providing timely and accurate information, supporting decision-making, and enhancing overall effectiveness

Early Detection

Fire Behavior Prediction

Resource Allocation

Fire Perimeter Mapping

Air Quality Monitoring

Community Alerts

Data Analysis

NASA'S SATELLITE AND DATA RESOURCES:

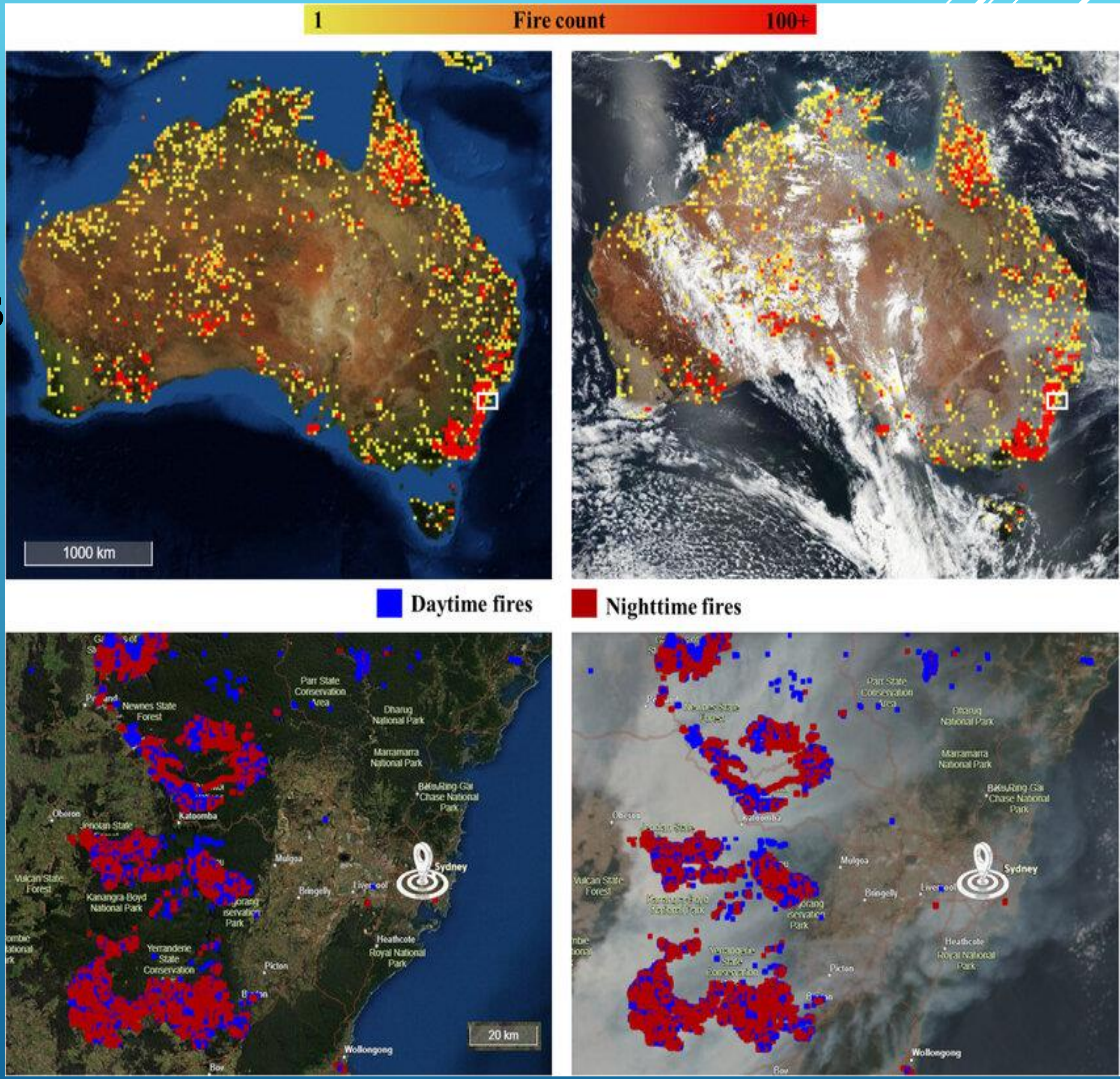
Moderate Resolution Imaging Spectroradiometer (MODIS)

Visible Infrared Imaging Radiometer Suite (VIIRS

Aqua and Terra Satellites

Land Data Products

Global Fire Emissions Database (GFED)s



METHODOLOGY STEPS

1. Data Collection
2. Data Preprocessing
3. Data Splitting
4. Wildfire CNN Architecture
5. Model Training
6. Hyperparameter Tuning
7. Model Evaluation
8. Model Testing
9. Integration with Wildfire Management Systems

RESULT

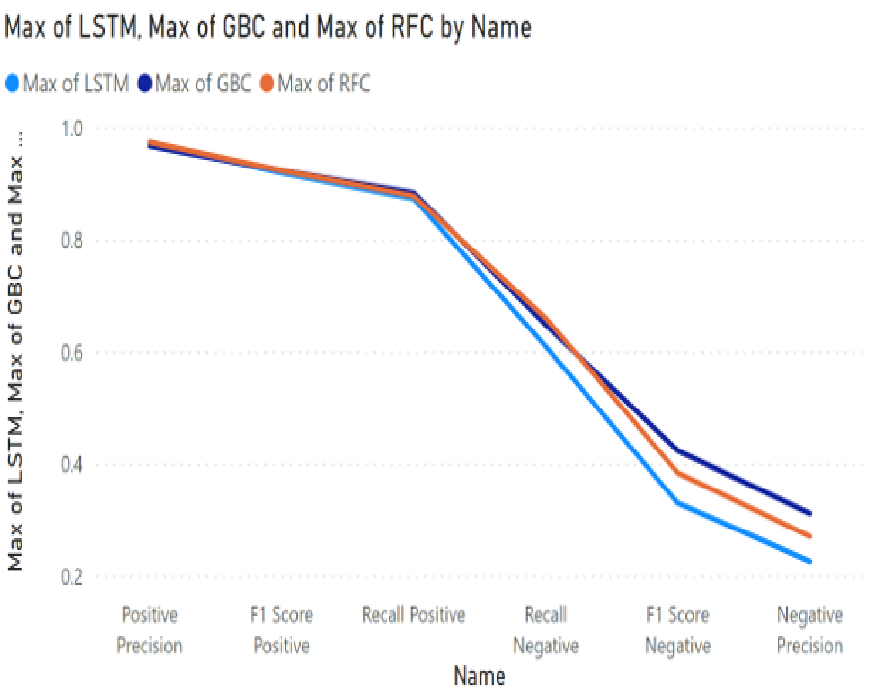
Our evaluation of the "wildfireCNN" model revealed outstanding performance across various aspects. It achieved high accuracy and precision in predicting wildfire attributes, including type and confidence levels. WildfireCNN holds promise for early wildfire detection, monitoring, and management, with potential for further improvements.

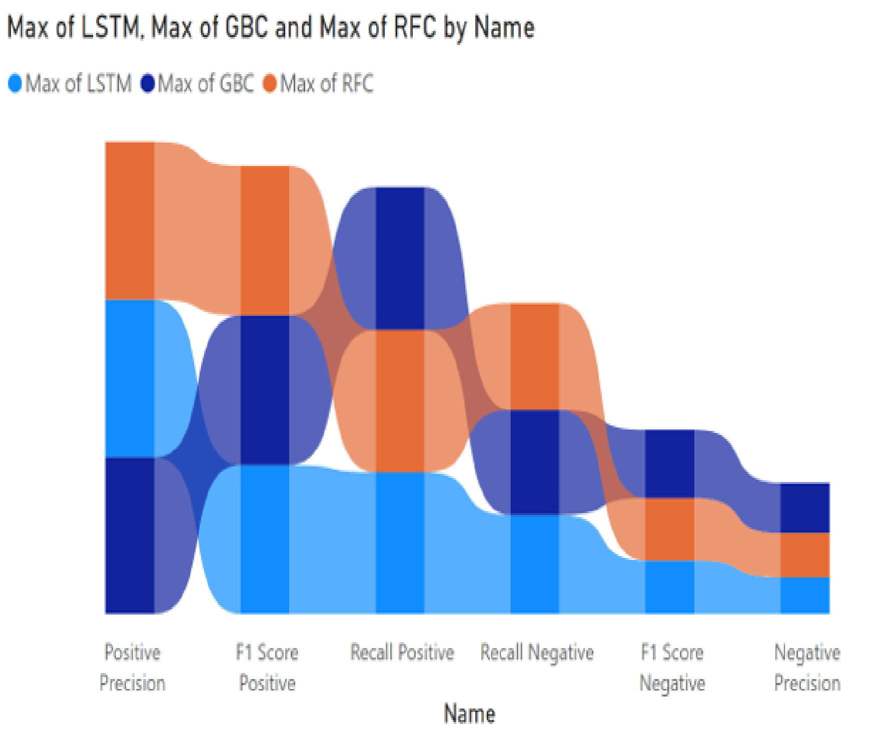
```
Epoch 1/10
500/500 [==============================] - 16s 31ms/step - loss: 0.4261 - accuracy: 0.8656 - val_loss: 0.1142 - val_accuracy: 0.9638
Epoch 2/10
500/500 [==============================] - 17s 34ms/step - loss: 0.1496 - accuracy: 0.9557 - val_loss: 0.0878 - val_accuracy: 0.9735
Epoch 3/10
500/500 [==============================] - 16s 33ms/step - loss: 0.1061 - accuracy: 0.9680 - val_loss: 0.0662 - val_accuracy: 0.9785
Epoch 4/10
500/500 [==============================] - 16s 32ms/step - loss: 0.0919 - accuracy: 0.9730 - val_loss: 0.0538 - val_accuracy: 0.9833
Epoch 5/10
500/500 [==============================] - 15s 30ms/step - loss: 0.0678 - accuracy: 0.9795 - val_loss: 0.0572 - val_accuracy: 0.9797
Epoch 6/10
500/500 [==============================] - 15s 30ms/step - loss: 0.0597 - accuracy: 0.9807 - val_loss: 0.0475 - val_accuracy: 0.9835
Epoch 7/10
500/500 [==============================] - 15s 31ms/step - loss: 0.0490 - accuracy: 0.9841 - val_loss: 0.0591 - val_accuracy: 0.9808
Epoch 8/10
500/500 [==============================] - 15s 30ms/step - loss: 0.0450 - accuracy: 0.9848 - val_loss: 0.0652 - val_accuracy: 0.9812
Epoch 9/10
500/500 [==============================] - 15s 30ms/step - loss: 0.0396 - accuracy: 0.9867 - val_loss: 0.0417 - val_accuracy: 0.9868
Epoch 10/10
500/500 [==============================] - 15s 30ms/step - loss: 0.0336 - accuracy: 0.9894 - val_loss: 0.0363 - val_accuracy: 0.9883
313/313 [==============================] - 3s 9ms/step - loss: 0.0350 - accuracy: 0.9890
Test accuracy: 0.9889988899230957
```

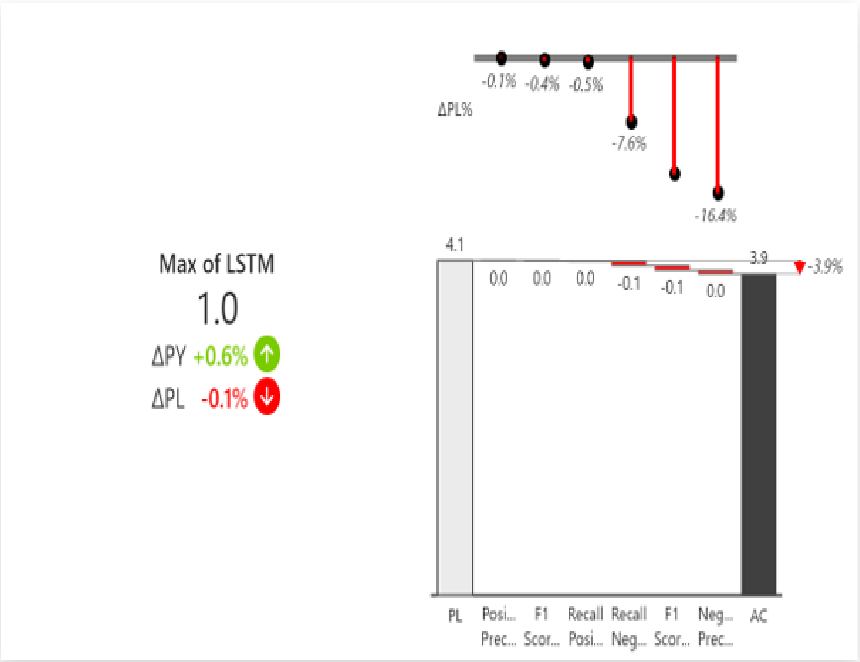
RESULT OF RFC GBC AND LSTM

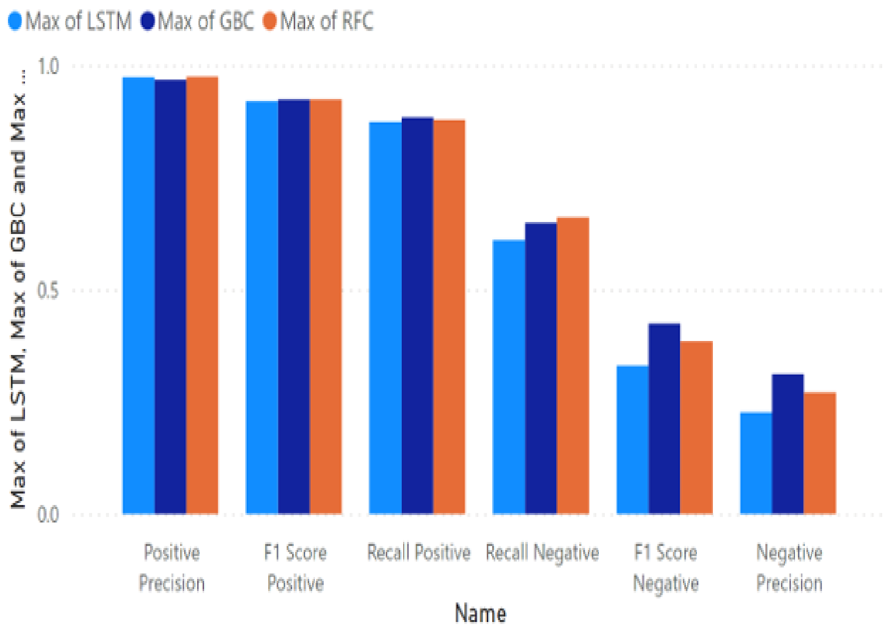
Name	RFC	GBC	LSTM
Positive Precision	0.9742	0.9672	0.9731
Negative Precision	0.2709	0.3120	0.2266
Recall Positive	0.8783	0.8837	0.8736
Recall Negative	0.6605	0.6486	0.6100
F1 Score Positive	0.9237	0.9235	0.9197
F1 Score Negative	0.3841	0.4240	0.3303

MAX OF LSTM GBC AND RFC









CONCLUSION

Our investigation into community-based fire management has yielded valuable insights and recommendations for enhancing wildfire prevention and management strategies. Through the application of machine learning algorithms such as Random Forest Classifier (RFC), Gradient Boosting Classifier (GBC), and Long Short-Term Memory (LSTM), we have demonstrated the potential for data-driven approaches to significantly contribute to the field. These models have allowed us to assess the effectiveness of community-based fire management initiatives, predict fire behavior, and evaluate the impact of various factors on wildfire outcomes. As we observed, each algorithm exhibited its own strengths and suitability for specific tasks, with RFC and GBC excelling in classification and LSTM providing valuable insights into time-dependent patterns.


THANK YOU!