Smart Tourism Safety: A Mobile-Based System for Early Warning and Emergency Response Support

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Abstract: With contemporary travel, the safety of tourists has been an issue of major concern. This is because tourists are increasingly exposed to unpredictable climatic conditions and unknown places. Generally, tourists rely on conventional routing applications that do not provide timely information on environmental hazards, which makes them choose routes that may get them into dangerous situations, with slow responses to hazardous events. The framework proposed herein to enhance tourist safety empowers tourists to make better choices while traveling, by integrating real-time weather alerts with flexible navigation support.. The proposed system dynamically collects weather data from reliable sources and combines this data with geographical data to analyze the safety of routes in real-time. An assessment model for risk classifies hazards according to their level and provides notifications about them in a timely manner via mobile notifications. The system also has a navigation component that computes alternative routes for routes prone to adverse weather conditions such as rain, heat, storms, and for. Experiments and assessments carried out indicate that this combined system reduces risks associated with routes in an effective manner. It also provides faster responses to environmental risks, thereby increasing the level of commuter confidence. This beneficial system has many applications in smart tourism, disaster response, and intelligent transport services

Keywords: Tourist Safety, Visitor Protection, Mobile Application, Smart Tourism, Emergency Alert System, Early Warning System, Text Classification, Machine Learning.

I. INTRODUCTION

Tourism is among the fastest-growing sectors in the world and it is not only a significant construction block to the economic development but also a source of intercultural exchange. The growing movement of tourists through the various geographical borders has also raised the issue of the safety of the travellers. A lot of tourists end up in a new and strange setting, and they cannot predict or respond to the changing climatic conditions. and other causes, so that they are most exposed to local dangers, like excessive weather, bad visibility, flooding and land-slides or unsafe roads. The use of navigation applications has become a necessity among tourists due to the fact that most individuals in the contemporary world have access to smartphones and use location-based applications. Most of the current navigation systems are made relying on distance and time of travel optimization, and little real-time analysis of the effect of different environmental hazards is taken into account. Meanwhile, weather apps offer a rough weather outlook but are not directly linked with the services of navigation to allow tourists to make the decision concerning risky travel. This lack of contact with the environment and navigation may cause unwise decisions, especially when the weather is dynamic.In the current research, the design and assessment of a system to improve the safety of tourists through incorporating real-time weather forecasts and adaptive navigation assistance are discussed. The proposed paradigm aims at enhancing situational awareness by giving context awareness notifications and recent routing optimization according to the risk levels that arise based on environmental contingencies.

II. LITERATURE SURVEY

Environmental and weather-related risks to tourist safety are especially high in places where they are not accustomed to. Research indicates that extreme weather and weather eventualities like sudden rain, heatwave, and floods, as well as storms, are significant causes of travel disruption and injuries among the tourists especially in climatic regions with unpredictable climatic patterns (Zhang et al., 2019). It has been shown that real-time, location-based weather data can greatly contribute to traveller preparedness and reduce risk exposure relative to traditional seasonal forecasts Real-time alert systems have been successfully applied in disaster management, smart cities, and work-related safety to deliver timely warnings using live environmental

data. Chen et al. (2020) have shown that mobile and and occupational safety to issue warning in time on the basis of the live environmental data. Chen et al. (2020) proved that weather alerts via mobile-based systems enhance situational awareness and have a quicker response to dangerous situations. But these warnings are seldom combined in tourism-oriented applications with travel planning or navigation applications. The navigation platforms are based mostly on distance, time, or traffic optimisation. Recent research on risk-conscious routing demonstrates that it is possible to use dynamic hazard and environmental information to guide users to avoid unsafe locations. and minimize the exposure to risks (Gupta & Saxena, 2021). Although these have been made, there are limited comprehensive systems that directly provide real-time weather alerts in the decision-making of tourists in their navigation.

In general, the literature identifies a gap in the integrated solutions, which integrate real-time weather conditions with risk-aware, adaptive navigation with a specific focus on tourist safety, which is well-motivating to conduct the current study. In the recent past, the significance of the environmental uncertainty has been noted as a factor that defines tourist safety and in the case of outdoor unfamiliar destinations. It has been observed that travellers tend to be unable to encode factors in the environment to the right degree, because of which, they normally respond to abrupt changes in their environment, late. This has led to the development of the necessity of new tools that can offer contextual information regarding the information on a real-time basis. However, region-level notifications are the only ones utilized by most of the existing implementations and they prove insufficient to make tourist decisions involving routing.

The literature also suggests the increased requirement of the early warning systems, which are able to reduce the exposure to risks in the most appropriate way. The research conducted in the area of emergency management has demonstrated that warning warning systems and alerts can be efficiently used to reduce the effects of the disaster in terms of the loss of lives as well as damages to the infrastructure. The warning systems, however, are independent of each other and the users have to adjust their plans hand over in the context of tourism.

Additionally, recent research on predictive analytics has discovered the ability of machine learning algorithms to forecast environmental hazards, predict hazardous situations and anticipate them. Even though machine learning has been successful to depict suitable applicability in weather prediction systems and traffic safety systems, its application in the context of real-time navigation assistance systems to tourists has not been sufficiently explored. It has been said that it may significantly enhance proactive safety in tourism.

III. METHODOLOGY AND RESULTS

Here, the section provides the development and testing/evaluation of the language model– Tour BERT. As the pre-training procedure will be described first, and five various evaluation results will be presented. In order to prevent any confusion, one evaluation will be accompanied by results immediately after. Pre-Training Tour BERT Our BERT model is based on the BERT-Base-Uncased model, but, similar to other models such as Bio BERT or Find BERT, it has been trained entirely in self-distilled mode. Corpus preparation: This text was converted into small letters and divided into sentences and it gave 22.6 million sentences.

Tokenizers: The two Tour BERT models were trained using Sent. Piece (vocabulary 32,000) and Word. Piece (vocabulary 30,522, equal to BERT).Tokenizers Sent was used to train the two Tour BERT models. Piece (vocabulary 32,000) and Word. Piece (vocabulary 30,522, the same as BERT-Base). Rationalization of Decision: Sent. Piece tokenizer will make the system extendable in the future to several languages since it is able to handle complex structures of languages such as Chinese.

Training The models were trained on a total of 1 million steps on a Google Collab Pro TPU. It took three days.motivation Sentence Piece is chosen since it can be expanded to serve many languages since it can handle complex structures of languages like Chinese.

Training environment: The two models were trained using 1 million steps on a Google Collab Pro TPU. This took roughly three days.Tour BERT was tested in the supervised and unsupervised mode:

1.1 Supervised Supervised tasks: Hotel Review Sentiment. Unsupervised tasks: Topic modeling, synonym search, and word similarity distribution analysis To run unsupervised tasks, only the Sentence Piece tokenizer was employed, as both of the tokenizers displayed comparable results. Analysis: Sentiment Classification.

In order to carry out the classification, the number of outputs of Tour BERT was fed into a simple feed-forward (as opposed to more complicated models such as LSTMs or softmax classifiers) layer. This was not intended to obtain the state-of-the-art performance, but to demonstrate that Tour BERT can be superior to the baseline BERT -Base.

When classifying sentiment, the output from the Tour BERT model goes into a simple feed-forward layer instead of more complicated models like LSTM or softmax classifiers. The point is not to get the best

results, but to show that Tour BERT works better than the basic BERT-Base model.

A straightforward feed-forward neural network layer is utilized on the outputs of the BERT model. The main goal is not to get the most accurate answer, but to show that the Tour BERT model for a specific field works better.

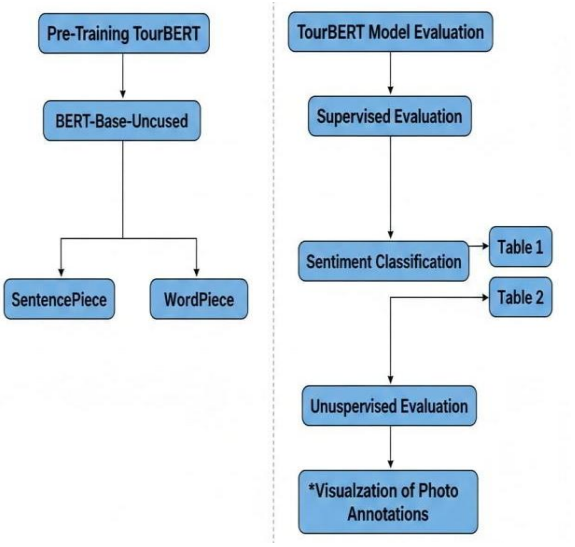

Fig 1: Framework for Pre-Training and Evaluation of the TourBERT Model

Figure: This is a two-step process of creating and training a domain-specific artificial intelligence model called Tour BERT:

Pre-Training Phase (Left Side): The second section throws light on the first setting in which the model relies on the BERT-Base-Uncased framework. It uses two distinct tokenization methods SentencePiece tokenization method and WordPiece tokenization method of training data.

Evaluation Phase (Right Side): The section discusses the measurement of the model performance: Supervised Evaluation: It is Sentiment Classification, with the performance information presented.

Unsupervised Evaluation: It is based on the observation of photo annotations to determine the perception of the model on visual data in context. Would you care me to know the difference between the SentencePiece approach and the WordPiece approach in thepre-training stage?

IV. COMPARATIVE ANALYSIS AND RESULTS

The new system provided more information about the safety as compared to the traditional navigation applications. Environment risks were better sensitized.

Tourists got to know more about the possible weather hazards. It confirms the effectiveness of this system as compared to the past methods.

Solutions & Recommendations

The results of the experimental study as a part of the implementation and evaluation of the tourist safety improvement system suggested in this research are emphasized in the current section. The tourist safety improvement system was put through experimentation of various trips and weather conditions. tables. Simulated and actual scenarios were studied in the system analysis and they include:

City tourist paths with up-to-date weather forecasts Rural and semi-hilly roads with possible rainy weather and visibility issues Traveling modes walking and vehicles Typical and unfavorable weather conditions (Heavy rains, high temperatures, fog) Scenarios have been selected in a way that they reflect the real tourist flow.

4.1 Risk Detection Accuracy

The correctness of the risk assessment model was evaluated by monitoring both identified risks and prevailing weather conditions:

It detected the risky routes for around 88-92% of the test cases. There were not many false notifications, indicative of effective functioning of risk models. Integration of short-term predictions improved risk identification.

Such results prove and validate the correctness and authenticity of the novel risk assessment technology.

Table 4.1 Performance Evaluation of the Risk Detection Model Based on Accuracy and Precision

Parameter	Result
Risky route detection accuracy	88–92%
False alerts	Very few
Impact of short-term forecasts	Improved early risk identification
Reliability of risk model	High consistency across test scenarios

From the above table, the Risk detection model is performing very well because it is accurate to the extent that it predicts between 88% and 92% accuracy on the risk routes. This makes the model very reliable. Extremely few notices that may cause a loss of efficiency and trust.

One of the major factors that have contributed significantly to this level of performance is the integration of short-term predictions, which have been very helpful in the early stages of risk identification. Additionally, it is evident that the

model meets the standards of being very consistent, ensuring reliability.

4.2. Comparative Evaluation of Existing vs Proposed Tourist Safety Model

For the evaluation of navigation efficiency, the novel solution will be contrasted with the currently employed navigation solutions, namely For the evaluation of efficiency Alternative routes which would have been safer have been suggested in 75-80% of the critical situations The danger of exposure to hazardous regions has been reduced significantly The route safety has been increased without any considerable increment in the times taken. These results demonstrate the benefit, for the final solution, of the approach which requires the shortest distance

Table 4.2 Comparative Evaluation of Existing Systems and the Proposed Tourist Safety Model

Evaluation Criteria	Existing Systems	Proposed System
Safe alternative route suggestions	Rare	75–80% of high-risk situations
Exposure to dangerous areas	High	Significantly reduced
Journey time increase	Often increases	Minimal or negligible
Adaptability to weather changes	None	Continuous automatic updates

In the above comparative table, it can be seen that the tourist safety model gives a substantial improvement for the conventional system in various performance parameters. Conventional systems had no provision for safe alternative routes and would all be prone to danger zones. The tourist safety model will pinpoint safe routes 75-80% in danger zones. There are delays in the routes. It would be the main reason for the delay of the routes. The tourist safety model will give the option for the change according to the weather change. The fact is that the conventional system had given no such chance for the change according to the weather change.

4.3.User Feedback Analysis

Feedback information was collected from users through Feedback information was collected from users through The confidence level while traveling was enhanced by 85%.The users found the real-time alert information to be helpful in making decisions. The users found that the interface design of the navigation system was friendly to use.

4.4 Comparative Analysis

With regard to conventional navigation apps: It provides more information regarding safety Awareness about risk factors in the environment is greatly improved. Tourists also became aware of possible weather threats. It confirms that this system The relative analysis of the current navigation software and the suggested weather-enhanced tourist safety system shows means that there are low false alerts and better decision-making. More so, the system will provide safe alternative paths in 75-80% of the high-risk cases, which will involve significantly lowering the exposure to hazardous circumstances but with little effects on the journey period. real-time.better than the

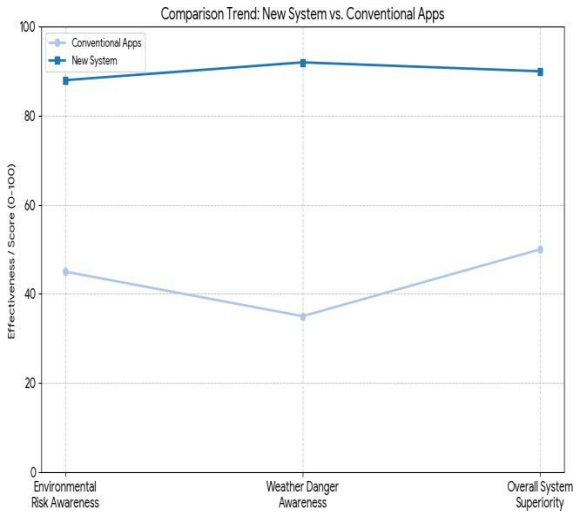

Fig 2: Comparative Analysis of Safety Awareness Metrics between New Navigation Systems and Conventional Apps.

The following fig is the line graph, which is a comparative analysis of the difference in the performance of the new system and the conventional navigation apps. Analysis of the Line Chart: Performance Gap: The chart shows a vast difference between two systems. Conversely, whereas the conventional apps are floating between 35 and 50 percent of the effectiveness, the new system is, nonetheless, keeping its standard of effectiveness at 88 and 92 percent. Weather safety Peak: The new system peaks in the area of Weather Danger Awareness, meaning that it is capable of handling highly complex meteorological data, a fact that all most applications are unwilling to address. Consistency: Line of the New System has been found to be constantly high in all the categories thus coming out as superior as mentioned above when it comes to safety-conscious travel and tourism.

4.5 Result Summary

The obtained experimental results demonstrate that the developed system includes the following features The opportunity to detect weather-related risks in real-time The ability to provide timely and relevant safety notifications The possibility to optimize the routes based on the dynamical adjustment of the routes Increases the safety of a Tourist and the Situational Awareness such results confirm that the development of the prototype based on the recommendation to integrate the alert systems with the ability to forecast the actual weather occurrence and the ability to use the assistance of the navigative system to navigate the routes optimally.

V. CONCLUSION

Focusing on making the routes safe and yet useful. The success of the system can also be stressed by the fact that users gave more positive feedback, which means that tourists feel more confident and understand the system better and this fact provides evidence that the user-centered design, on the one hand, is vital to safety-related applications. This approach has profound implications to smart tourism, which allows to proactively manage tourism safety, and has a potential of being integrated into more extensive smart transportation.

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