ISSN 2277-2685
IJESR/Jan-Mar. 2025/ Vol-15/Issue-1s/648-655
Manchikanti Aishwarya *et. al.,* / International Journal of Engineering & Science Research

Pre Warning System For Weak Houses And Bridges Using Gsm

[1]Dr. K Ashok Kumar, [2]Manchikanti Aishwarya, [3]Dasari Ashwini, [4]Pasunuri Devi Sri
[1]Associate professor, Department of ECE, Bhoj Reddy Engineering College for Women, India
[2,3]B.Tech Students, Department of ECE, Bhoj Reddy Engineering College for Women, India

ABSTRACT

In this project the alert is made about weak bridges and Houses that may destroy and having a risk of collapsing. The main aim of the project is to avoid hazards. Early warning systems are the systems by which people receive relevant and timely information in systematic way. Early action can often prevent a hazard turning into a human disaster by preventing loss of life and reducing the economic and material impacts.

In this bridge or House monitoring system is significant to the structural health monitoring of both old/new bridges and flyovers an infrastructure daily used by citizens of their respective countries. In this system we use MEMS sensor for Dislocation or uneven movement of the bridge or house, flex sensor is used to crack detection, and a Atmega328 micro controller is used for processing the data and to react according to the instructions and alert the system whenever there is a un even conduction occurred using GSM technology via SMS.

1-INTRODUCTION

Bridge Safety Monitoring System is developed using the embedded technology. This system is composed of monitoring devices installed in the bridge environment including the communication devices connecting the bridge monitoring devices and the cloud-based server, and a cloud-based server that calculates and analyzes data transmitted from the monitoring devices. This system can monitor and analyze the conditions of a bridge and its environment, including the force levels nearby, vibration and other safety conditions. The detected data are transmitted to the server and database for users to have real-time monitoring of the bridge conditions with the help of mobile telecommunication devices.

Many bridges in cites are at the river bank which are mostly not in good conditions as they had been constructed long years ago which need to maintained on regular basis. Due to heavy load of vehicles, high water flow, heavy rains these bridges may get collapse which in turn leads to disaster. So, these bridges require continuous monitoring.

So, this paper proposes a system which consists of a weight sensor, vibration sensor, water force sensor, Wi-Fi module, and ARM microcontroller. This system detects the load of vehicles and if the value rises above threshold, it generates an alarm, then the concerned authority can assign the task to the employees for maintenance.

This system can monitor and analyses in real time the conditions of a bridge and its environment, including the waters levels nearby, pipelines, air and other safety conditions. The detected data and images are transmitted to the server and database for users to have real time monitoring of the bridge conditions via mobile telecommunication devices.

The data can be used for bridge safety management and, in the occurrence of a disaster, for disaster rescue. For its monitoring and information communication, this system uses the embedded technology, a technology characterized by low power consumption, high safety and support of a large number of network works.

In addition, solar energy is used as a supplementary power source for the system to reduce its costs. The system developed in this study can help promote the advancement of bridge safety management and control by providing breakthroughs to the above-mentioned problems of conventional systems.

As urbanization accelerates, many buildings, especially older structures, face increasing risks due to environmental factors like earthquakes, heavy winds, and structural degradation. These vulnerabilities necessitate proactive measures to ensure the safety of inhabitants. A pre- warning system for weak houses and buildings using GSM (Global System for Mobile Communications) technology offers a viable solution to enhance safety and minimize risks.

This system employs sensors to monitor structural integrity, detecting signs of potential failure or hazardous conditions. By integrating GSM technology, the system can instantly send alerts to homeowners and relevant authorities via SMS or calls, facilitating timely evacuations and preventive measures.

2-LITERATURE SURVEY

Developing countries such as China are currently implementing large-scale bridge projects. However, these projects require large project investment, complex technology, and extensive contents and are typically established in poor construction environments. This results inextremely high construction safety, with an enhanced probability of serious accidents. In recent years, bridge construction safety accidents (e.g., the impact of the cofferdam, the collapse of floating cranes, and flooding) have been a common occurrence The early warning of construction safety risk generally involves the monitoring, evaluation, and prediction of factors corresponding to construction safety risk, with the aims of predicting future risks, determining the potential time range of risks, and measuring the strength of risks and their damage degree. Such a system aids decision- makers in taking appropriate risk control measures . Therefore, the systematic identification, estimation, and early warning control of bridge construction safety risks can effectively reduce construction safety risks and achieve the management goals of bridges while complying with safety regulations.

Numerous scholars have performed in-depth studies on the early warning of risk in many fields. To effectively reduce the financial risks of non-life-insurance enterprises, Yan et al. constructed a financial risk early-warning model. Zhang developed a safety risk early- warning model of the food industry chain, revealing that introducing early warning theory into the field of food safety risk can effectively improve the level of risk management. In order to reduce the loss of ship collision, Cheng et al. introduced risk early warning theory into ship collision risk management. Based on climatology, disaster science, and environmental science, Zhang et al. determined that the risk early warning theory should be introduced into the early management of the drought disaster risk of crops such as corn. Sattlee et al. integrated risk early warning theory into the reliability analysis of geological disasters to effectively reduce the losses caused by landslides and falling rocks. Great achievements have been made in the theory of early warning risk, but the research results on early warning of bridge construction safety risk are rarely reported. The early warning of risk denotes the prediction or classification of the target value of research objects. Scholars have adopted various research methods to build risk early-warning models across

different fields of research. Ding comprehensively combined the analytic hierarchy process (AHP) and the fuzzy comprehensive evaluation method to construct the risk early- warning model of financial enterprises. However, the fuzzy comprehensive evaluation is a linear weighted evaluation method and cannot effectively reflect the elevated influence of all evaluation indicators. Nonlinear characteristics are also unable to meet the requirements of practical evaluations. The AHP is associated with several disadvantages, such as strong subjectivity and the sensitivity to extreme expert opinions. Based on the strong self-learning ability and nonlinear processing of artificial neural networks (ANNs), Yan et al. constructed an early-warning model of human resource management risk based on the back propagation neural network (BPNN). However, the application of the BPNN in early warning risk research results in several shortcomings, including overfitting, slow convergence, and easy to fall into a local minimum. Wang et al. employed the grey model (GM) to construct an early warning safety risk model of a railway service system. Although the GM is simple to operate, it requires that variables satisfy the multivariate normal distribution, which is difficult to meet in practical applications. Chen and Zhang used the logistic regression model to construct a logistics-based early warning risk management system for the default risk of cultural creative crowdfunding projects. However, the calculation of the logistic regression model is approximate and thus has several shortcomings, such as complex calculations and
low prediction accuracy.

The least square support vector machine (LSSVM) inherits the structural risk concept and kernel mapping concept of the standard support vector machine (SVM). Starting from the loss function of machine learning, two norms are used in the objective function of the optimization problem in the LSSVM, and equality constraint is used instead of inequality constraint in SVM standard algorithm, which makes the solution of optimization problem of LSSVM method become a set of linear equations obtained by Kuhn–Tucker condition. The LSSVM trains the SVM by solving the transformed linear equations, which greatly improves the training efficiency of the SVM . In recent years, the LSSVM has been widely used in data prediction, data classification, and other research fields. Zhao et al. used the LSSVM to effectively diagnose aircraft engine faults. Ahmadi et al. successfully simulated the vaporization enthalpies of pure hydrocarbons and petroleum fractions via the LSSVM. Statistical results determined the LSSVM-predicted average relative deviation and of the vaporization enthalpies as 0.51% and 0.9998, respectively, indicating the high prediction
accuracy of the LSSVM. To improve the prediction accuracy of the cotton fabric *K*/*S* value, Yu et al. combined particle swarm optimization (PSO) with the LSSVM to construct a new prediction model. In order to overcome the low early warning accuracy, in the current study, the LSSVM is employed to build an early-warning model of bridge construction safety risk.

Despite its strong robustness and generalization ability, the LSSVM cannot simplify the dimensions of information space. For high dimensions or large training samples, the LSSVM often faces problems, such as dimension disaster, and an increase in time consumption due to the limited memory capacity or complex network structure. The rough set (RS) does not require any prior knowledge and removes redundant data without affecting the classification accuracy. It is widely used in the fields of attribute sets and key indicator screening. Introducing the RS into the LSSVM can effectively determine key attributes and reduce the adverse effects of redundancy and multicollinearity among various input variables on prediction accuracy. Therefore, when developing the proposed early-warning model based on the LSSVM, the RS is introduced to solve the problem of multiple early warning factors.

As a new machine learning method, the prediction accuracy and computational performance of the LSSVM depend on the reasonable selection of regularization and kernel width parameters. In the development of a landslide displacement prediction model for rainfall, Zhu et al. employed the genetic algorithm (GA) to determine the LSSVM optimal parameters. However, the GA is associated with several bottlenecks, including complex coding, a slow calculation speed, and easy premature convergence. To improve the accuracy of the LSSVM in predicting concrete strength, Xue optimized the calculation parameters via PSO. However, the PSO is also prone to premature convergence (particularly when dealing with complex multimodal search problems) and has a poor local optimization ability.

The sparrow search algorithm (SSA) is a new swarm intelligence optimization approach that was inspired by the foraging and antipredation behaviours of sparrows. When predicting the deboning strain of fibre reinforced polymer reinforced concrete, Li et al. employed the SSA to optimize the initial weight and threshold of the BPNN. Empirical results revealed that the SSA-optimized BPNN surpassed the traditional version in terms of prediction accuracy and robustness. Liu and Rodriguez used the SSA to accurately solve the problem of sustainable energy optimization in residential engineering, a complex and multiobjective nonlinear optimization problem. Wumaier et al. adopted the SSA to optimize the SVM parameter combination, and based on wind turbine fault diagnosis data, the SSA-SVM was clearly superior to GA-SVM and PSO-SVM in terms of computing performance. Therefore, the SSA in the proposed method was adopted to determine the LSSVM optimal parameter for efficient computing performance.

Based on the above analysis and review of the relevant literature, a hybrid early-warning model of bridge construction safety risk was developed based on the RS, SSA, and LSSVM. The contributions and innovations of this article are as follows. At present, researches on the early warning of risk mainly focuses on the financial risk, the food safety, the disaster risk, or other fields. In this study, early warning for the construction safety risk of bridge projects was studied, and a detailed case study was made. This provided new insights for early warning and management of bridge construction project. From five aspects (men, machines, materials, methods, and environment), the index system of early warning for construction safety risk of bridge projects was constructed completely, which provided reference and foundation for similar researches. In this study, a novel early- warning model based on the RS, SSA, and LSSVM was constructed, which not only effectively solved the problem of multiple risk early warning factors but also overcame the problem of low precision of traditional early warning methods.

3-HARDWARE AND SOFTWARE DESCRIPTION

Hardware Description

Arduino

The Arduino nano is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Revision Of The Board Has The Following New Features

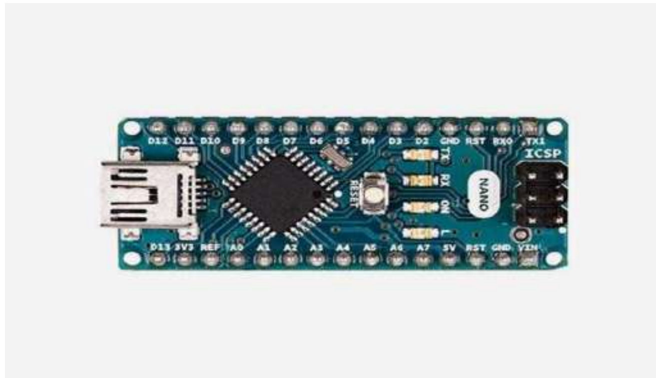

Figure 2.1: Arduino Nano Chip

SOFTWARE DESCRIPTION

AURDINO IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

4-METHODOLOGY

Existing System

Existing pre-warning systems for weak houses and bridges utilize various technologies to predict and mitigate potential hazards. For houses, systems like FloodMap, HazardHub, and the National Flood Hazard Layer provide flood risk assessments, while Earthquake Early Warning Systems and Structural Health Monitoring systems detect seismic activity and structural weaknesses. For bridges, the National Bridge Inventory and Bridge Inspection Systems track condition and structural integrity, supplemented by Scour Monitoring Systems and Load Capacity Analysis. General early warning systems include the National Weather Service, Emergency Alert System, and Cell Broadcast. These systems employ technologies such as IoT sensors, drones, AI, GIS, computer vision, and structural analysis software. Despite advancements, challenges persist, including integrating data, improving prediction accuracy, enhancing public awareness, and addressing infrastructure vulnerabilities. Ongoing research aims to enhance these systems, integrating emerging technologies to protect lives and infrastructure.

Proposed System

The structural integrity of buildings and bridges is vital for public safety and the sustainability of urban environments. Structural failures can result in devastating consequences, including loss of life and significant economic impact. Traditional inspection methods are often insufficient, as they rely on periodic assessments that may overlook subtle signs of deterioration. To address these challenges, a Pre-Warning System utilizing Global System for Mobile Communications (GSM) technology offers a proactive approach to monitoring and ensuring the safety of weak structures.

1. Bridges and houses should be monitored periodically in order to assess the bridge health at any given time.
2. The sensors send the acceleration and displacement data of a bridge response under earthquakes loading to the system server.
3. This study aims to conduct the early-warning intelligent system based upon the performance of the acceleration and displacement data and inform with the help of SMS platform.

5-ADVANTAGES, DISADVANTAGES AND APPLICATIONS

Advantages

1. **Early Detection of Structural Issues**: Continuous monitoring allows for the early identification of anomalies, such as cracks or excessive vibrations, enabling timely intervention before failures occur.
2. **Real-Time Alerts**: The GSM technology facilitates instant notifications to engineers and maintenance teams when critical thresholds are exceeded, ensuring swift action to mitigate risks.
3. **Cost-Effectiveness**: By preventing catastrophic failures, the system can save significant repair costs and reduce economic losses associated with structural collapses.

Disadvantages

1. **Initial Setup Costs**: The installation of sensors, data acquisition units, and GSM modules can require a significant upfront investment, which may be a barrier for some communities or organizations.
2. **Environmental Factors**: Extreme weather conditions or environmental changes can affect sensor performance and data accuracy, necessitating robust design and protection measures.

Applications

1. **Structural Health Monitoring**: The system can be deployed in residential buildings, commercial structures, and bridges to continuously monitor health indicators like strain, displacement, and vibrations, ensuring structural integrity over time.
2. **Disaster Management**: In earthquake-prone regions, the system can provide early warnings of potential structural failures due to seismic activity, helping local authorities and emergency services prepare for evacuations and safety measures.
3. **Urban Infrastructure Management**: Municipalities can use the system to monitor public infrastructure such as bridges and overpasses, enabling proactive maintenance and timely repairs, thereby extending the lifespan of critical assets.

6-RESULTS AND DISCUSSION

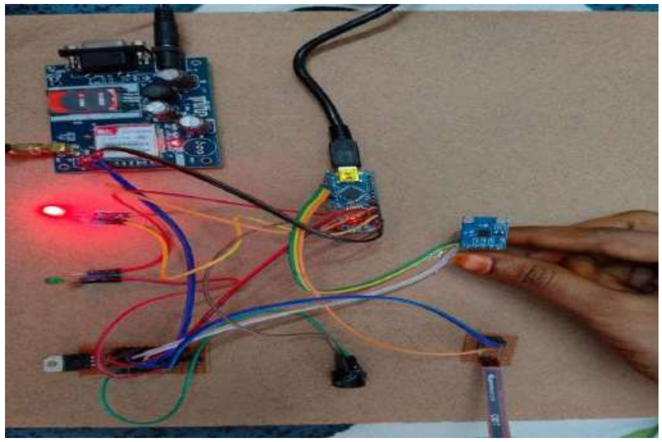

Figure5.1:When Danger is detected The figure 5.1 shows the result when bend or crack is detected.

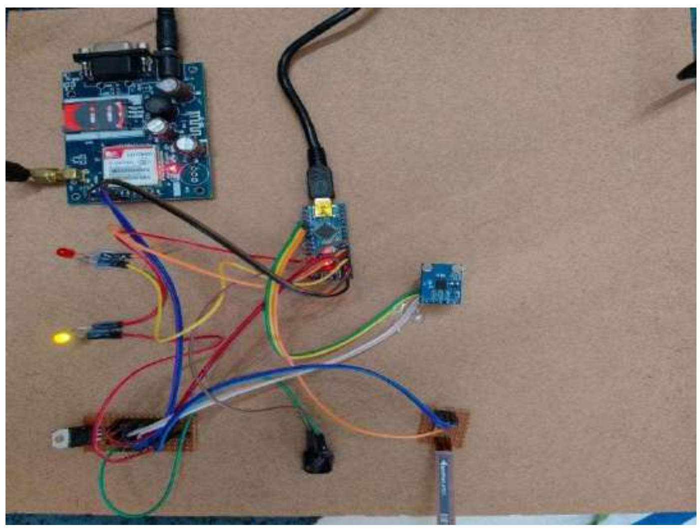

Figure5.2:When no Danger is detected

7-CONCLUSION AND FUTURE SCOPE

Conclusion

The bridge health and house health system used several sensors to detect the behavior of a bridge and house such as bridge deformation and damage. The sensors connected to the data logger and subsequently sent the information data such as coordinates and crack to the microcontroller. The data is used as input by microcontroller within the system and gives as a command to the alerting unit.

Future scope

We can interface the wireless communication system to this system so that it can send the information to the control station or the emergency control organization.This system can be enhance by implementing the prevention mechanism like automatic closing of gates on the bridge.Integrating With IOT based Technology.

8-REFERENCES

1. Suryanita R, Adnan A (2013) Application of neural networks in bridge health prediction based on acceleration and displacement data domain. In: Lecture notes in engineering and computer science: proceedings of the international multiconference of engineers and computer scientists 2013, vol 2202(1). Hong Kong, pp 42–47, 13–15 March 2013

2. Kerh T, Huang C, Gunaratnam D (2011) Neural network approach for analyzing seismic data to identify potentially hazardous bridges. Math Prob Eng 1–15

3. Ok S, Son W, Lim YM (2012) A study of the use of artificial neural networks to estimate dynamic displacements due to dynamic loads in bridges. J Phys: Conf Ser 382(1)

4. Cheng J, Li QS (2012) Artificial neural network-based response surface methods for reliability analysis of pre-stressed concrete bridges. Struct Infrastruct Eng 8(2):171– 184

5. Maizir H, Kassim KA (2013) Neural network application in prediction of axial bearing capacity of driven piles. In: Proceedings of the international multiconference of engineers and computer scientists 2013, vol 2202(1). Hong Kong, pp 51–55, 13–
15 March 2013

6. "False Alarms in the Nuclear Age". PBS. 6 November 2001. Retrieved 28 October 2021.

7. Lampe, Hannes; Herschinger, Eva; Nitzl, Christian; Willems, Jurgen (2024-06- 03). "Predicting Novel Terrorism: Media Coverage as Early-Warning System of Novelty in Terror Attacks".

8. Lampe, Hannes; Herschinger, Eva; Nitzl, Christian; Willems, Jurgen (2024-06- 03). "Predicting Novel Terrorism: Media Coverage as Early-Warning System of Novelty in Terror Attacks".