Smart System for Monuments and Bridges using IoT

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ABSTRACT: The opportunities and the challenges of applying IoT to culture preservation and revitalization of historical buildings, monuments and bridges have been focused. The aim of “Smart System for Monuments and Bridges using IoT” is to improve preservation, revitalization, livability, and sustainability. Different from the focus of smart city based on the needs of living in the present this system have been developed. The objective of proposed system is preservation of historical monuments. As blessed with the good and outstanding history, it is our duty to preserve them as long as we can so the next generation can also have the proofs and evidences of it.


I. INTRODUCTION

IoT describes a world where anything can be connected and communicated in an intelligent fashion. In simple words it is a network of different physical objects that can interact with each other to share information and take action. This term was first proposed by Kevin Ashton in year 1999 and this concept became popular at auto-ID center, MIT[1]. This has been adopted in the Padova Smart City project, which gives proof of deployment of an IoT island in the city of Padova, Italy, performed in collaboration with the city municipality[2]. This concept of IoT not only helps to create and implement new things but also it is used to preserve the past i.e. preservation of cultural heritage and historical monuments. Smart city concept not only means the creation of new but also the conservation of monuments, forts, gates and bridges.

Proper maintenance of the historical buildings and bridges requires the continuous monitoring of the actual conditions of each building and bridges and identification of the areas that are most subject to the impact of external agents. The IoT provides a distributed database of building structural integrity measurements, collected by suitable sensors located in the buildings and on the bridges, such as vibration and pressure sensors to monitor the building and bridge stress, and temperature and humidity sensors to have a complete characterization of the environmental conditions. This database reduces the need for expensive periodic structural testing by human operators and allows targeted and proactive maintenance and restoration actions. It is possible to combine vibration and pressure readings in order to better study and understand the impact of light earthquakes on historical buildings and bridges. This database is made publicly accessible in order to make the citizens aware of the care taken in preserving the historical heritage and bridges.

II. RELATED WORK

The estimation of mechanical properties of concrete is carried out by several methods which include destructive and non-destructive methods. J. Helal et al describes the most common non-destructive testing (NDT) methods of concrete structures. NDT of concrete was found to be gaining increasing acceptance as a means of evaluating the strength, uniformity, durability and other properties of existing concrete structures. It relies on comparing tested parameters with established correlations. Observed relationships provided by manufacturers were found to be often provided unsatisfactory results[3]. Nazarian et al. describes non-destructive tests which are widely applied to study mechanical properties and integrity of concrete[4]. The crushing of the samples is the usual destructive test to determine the concrete strength. The rebound hammer test and the ultrasonic device are used in the field of non-destructive tests to determine respectively the compression strength and the ultrasonic pulse velocity (UPV) in the concrete[5]. Hisao Emoto et al. describes methods for physically checking and predicting the remaining life of an aged...
III. PROPOSED SYSTEM

The proposed system is used for real time data analysis of a few physical variables which is divided among the various sensors. Such a device would be extremely beneficial to keep a check on parameters where constant monitoring is required. It includes various blocks such as ESP8266 Wi-Fi development kit, router and sensor equipment. Various sensors are interfaced with ESP8266 Wi-Fi development kit to detect various parameters such as vibration, pressure and temperature.

![Diagram](image)

**Fig.1. Block Diagram**

The vibration sensor which is SW-18020p series sensor isa spring type, no directional vibration sensor trigger switch, which can be triggered at any angle. Sensor acts as an open circuit when it is static or off state, when external force to touch occurs and corresponding vibration, or movement speed achieve adequate (partial) centrifugal force, conductive pick feet will produce instant conductivity is instant ON-state, when external force disappear, switch back to open circuit OFF-state. The next sensor is BMP180 a new digital barometric pressure sensor, with a very high performance, which enables applications in advanced mobile devices, such as smart phones, tablet PCs and sports devices. The ESP 8266 development kit offers a complete and self-contained Wi-Fi networking solution. It is a 80Mhz 32Bit Tensilica L106 CPU which integrates GPIO, PWM, I2C and 10-bit ADC all in one board. Operating voltage of development kit is 3.0V ~ 3.6V whereas operating current average value is 80mA. It operates at temperature range between -40°C ~ 125°C. The ESP8266 module is an extremely cost effective board with a huge and ever growing community, Wi-Fi module gets connected to the router and the output is displayed on ThingSpeak which is an open source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network. ThingSpeak enables the creation of sensor logging applications and a social network of things with real time status updates, plotting real time graphs and data of the sensors.

IV. RESULTS

To assemble this environment, software used is Arduino IDE. The result is observed on serial monitor who has been connected to the cloud through a possibly wireless internet connection to upload or receive data. Objects connected are typically augmented with different sensors such as pressure, temperature and vibration. For the purpose of connecting an object to the IoT, the ThingSpeak API is used which gives the current updates of the bridges, monuments and buildings to an individual. During the experimental setup values from various sensors for different dates have been
Figure 2 illustrates real-time graphs of various sensors for four different dates: 20th Feb, 27th Feb, 6th March, and 13th March. The figure shown below displays pressure readings observed on different days. On 20th Feb, a pressure reading of 94750 Pa was observed, which was higher compared to the other readings. It slightly declined thereafter. On 27th Feb, it was 94500 Pa, and on 6th March, it declined to 94240 Pa, the lowest reading taken. On 13th March, it slightly increased to 94622 Pa.

Fig. 2. Field Charts for Pressure

These are the readings of the temperature sensor observed simultaneously with the pressure sensor. Temperature observed on 20th Feb was 33.12°C. It varied on different dates. On 27th Feb, it was 31.84°C, whereas on 6th March, it was 31.20°C, and on 13th March, it was 32.4°C.

Fig. 3. Field Charts for Temperature

Very fluctuating readings were observed with the vibration sensor. Before 20th Feb, vibrations were above 15, and on 20th Feb, it was 9. It remained near to 9 till 6th March. After 6th March, it increased suddenly to 17. Between 6th March and 13th March, it decreased suddenly to 9 and increased to 17 after 13th March. From the obtained values, it is observed that for each date, the values obtained are different for pressure, temperature, and vibration sensors.
V. CONCLUSION AND FUTURE WORK

The proposed system overcomes all other system because of its low cost and high performance quality. Such a system would be extremely beneficial to keep a check on parameters where constant real time monitoring is required. Unlike other system this gives the current updates of the bridges, monuments and buildings to an individual at remote places. It can also be used in developments of smart cities to preserve smart structures. Also, this system analyzes the solution for the implementation of the system which can save lives and preserve history.

REFERENCES