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NEXT GENERATION OF STRUCTURAL HEALTH MONITORING SYSTEM BASED ON AUTOMATION APPROACH

Nowadays the world is moving towards informatization, digitization and it can be seen on the example of Ukraine. The use of information technologies in the construction sector, in particular, for the task of Structural Health Monitoring (SHM), allows to obtain the high-quality information about the state of the object in real time scale. SHM has been a subject of study for over thirty years. During this time a lot of research has been carried out, prototypes of systems have been built, and working solutions that fulfil the task of monitoring have been built. Development of automated SHM is a new step in the development of this technology.

Modern SHM system at the hardware level is based on wireless sensors which are also called as sensor node. The sensitive element of the sensor for building monitoring is usually a 3-axis accelerometer, that allows us to measure acceleration along all axes X, Y, Z. Such digital accelerometers as LIS3DSH, ADXL362, MPU6050, KX023, MPU9255 can be used in monitoring systems too.

The core of the sensor is a microcontroller that must support modern communication protocols based on the IEEE 802.15.4 standard, such as: Bluetooth, Zigbee, Loravan. In addition, the selected microcontroller must have sufficient computing to execute the user program.

To implement an automated approach, it is necessary to use the appropriate data processing algorithms. In general, the damage identification process can be divided into four sublevels. [1]

1. Detection allows you to get information about the presence of structural damage:
   - 1.1. Selection and placement of a wireless sensor;
   - 1.2. Collection of raw raw data;
   - 1.3. Transfer of data to an intermediate node or to a data processing server;
   - 1.4. Data processing and management;
   - 1.5. Monitoring of processed data;
   - 1.6. Making a decision about the current state of the object;
2. Localization is the obtaining of damage location in structure;
3. Degree is the obtaining of a certain metric of the damage severity and/or recommendations for inspection and maintenance;
4. Forecast is the ability to predict probable losses.

Certain data processing algorithms are used at each clarification data level. If the main goal of the system is the use of cheap element base, real-time monitoring and fast system implementation, then you should use statistical methods such as Chi-squared distribution, Euclidean space, Mahalanobis distance, Cluster analysis.

But if it is necessary to create an accurate system and there is enough time to collect data and current state information is available for training, then you can use more powerful methods such as Neural Networks (single, multilayer, convolutional, recurrent). [2]

The obtained results make it possible to spread the concept of automation in SHM. It allows the use of arrays of wireless sensor networks for the purpose of automatic adjustment and autonomous decision-making regarding the current situation. The resulting developments can be used for the educational process.

In addition, SHM can be used as a system for post-emergency situations that occurred as a result of the impact of various elements due to natural disasters, hitting rockets, etc. SHM system is very useful when it is necessary to assess the condition of the building for cases of dismantling rubble and rescuing people.

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AUTOMATED CONTROL OF AIR-DUST MIXTURE PARAMETERS DURING THE GRINDING OF CEMENT CLINKER

The production of cement requires intensive aspiration in the operation of cement mills to increase the productivity and preserve the environment because the dust emitted is hazardous to all living beings. Cement dust and its compounds have harmful effects on the respiratory system; excess exposure can lead to diseases in the upper parts of the lungs and negatively impact the skin and eyes. Prolonged interaction with the dust in the human body can result in chronic conditions such as respiratory tract inflammation and may lead to illnesses like influenza, bronchitis, tracheitis, and even certain forms of cancer. [1] Therefore, it is crucial to purify the air as soon as possible after the grinding of Portland cement.

The regulation of the air-dust mixture density before the aspiration shaft depends on its size. The velocity of the mixture within the shaft in the range of 1-1.5 m/s is allowed for the settling of one-fifth of the total dust and for creating normal conditions for further air purification in cyclones and bag filters. In the shaft, the mixture velocity enables the retention of one-fifth of the dust, establishing normal conditions for the subsequent air purification in cyclones and bag filters.

To assess the efficiency of aspirated air purification, a literature and patent search was conducted. As a result, a copyright sertificate was found. It is proposed to use a photodetector to determine the concentration of the air-dust mixture. [2] The operation of the photodetector is based on the photoelectric effect, comparing the amount of scattered light with the light passing through clean air. This sensor is suggested to be installed on the technological pipeline at various cleaning stages: before the aspiration shaft, after cyclones and after bag filters. Subsequently, all measurements are transmitted to the microprocessor controller MIK-52 and the computer.

By utilizing photodetectors and a hardware-software complex based on the microcontroller MIK-52 at different stages of aspirated air purification, control over the quality of purification can be achieved and the efficiency of the system in the production of Portland cement can be determined.

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