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Detection of Scour Depth Using IoT

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***Abstract*—The main aim of the proposed work is to detection of scour depth using IoT. The complex nature of the changes in the current and movement of the riverbeds by bridge scouring, it is impossible to understand or predict these changes. A reliable information, it's crucial to possess the present strategies and instrumentation for measurement bridge scouring replaced with technology that might acquire period bridge scouring information.**

***Index Terms*—Piezoelectric sensor, Arduino Uno, Iot, data analyser.**

I. Introduction

An upgraded electricity film kind time period scour observation sensing element put in on the bridge pier is conferred. The core plan of developing this scouring sensing system relies on the physical characteristic that output voltage may be generated because the electricity film is misshapen by the flowing media. Therefore, a sensing device may be created by mounting electricity skinny films on the rod at a set distance and inserting them into a guide rail beside the bridge pier. The electricity film embedded within the soil of the river bottom is undisturbed and therefore the output voltage is way smaller than the one disturbed by the water current. From the output signals of all the electricity sensors with identified locations on the depth of the pier foundation, one will trace the variation of the soil/water interface before, throughout and when a flood [1]. Compared with different styles of scouring sensors, this electricity kind scouring sensing element is sturdy, sensitive, and value effective and works in time period while not the necessity for power. During this paper, a sign process technique and performance tests in laboratory of this novel electricity film kind scouring device introduced initial. The installation and performance of the system within the field is additionally self-addressed.

A. Techniques Available to Detecting the Depth of the Scour

- Parallel seismic survey (PSS)
- Reverse Parallel Seismic Survey (RPSS)
- Pneumatic Scour Detection System (PSDS)

B. Parallel Seismic Survey:

The Parallel Seismic Survey (PSS) is based on analysis of seismic refraction waves generated in the pile or drilled shaft. The refracted waves are recorded by a vertical array of hydrophones in a cased hole about 100 mm (4in) inside diameter that has been inserted vertically into the subsurface adjacent to the foundation. This refraction-based method is especially efficient at measuring the thickness of the scour zone when the scour zone has been filled with silt or loose sand after the flood surge has passed. The zone of silt or loose sand acts as an acoustical muffler and strongly attenuates .the seismic energy transmitted to each hydrophone when the refracted waves pass through the scour zone. The attenuation of seismic energy through competent soil is much less than that of the silt or loose sand. The effect of this relative difference in seismic energy attenuation between the soil-filled scour zone and the competent soil below the scour zone is quite striking and the transition from transmission through the scour zone to transmission through competent soil is easily identified in the data. A simple extension of this technique allows the depth to the bottom of the foundation to be determined. If the depth of the cased hole is 3 to 5 m (10 to 15 ft.) deeper than the maximum expected length of the pile or drilled shaft, then the resulting data also provide the depth of the pile or shaft(hereafter called "pile") toe. The extension is to record the seismic waves to a depth below the bottom of the pile where the refraction wave converts to a diffraction wave radiating from the bottom of the pile. Straightforward data analysis of noting where the first break pattern changes from a straight-line refraction path to a hyperbolic diffraction path identifies the bottom of the pile. A field test of the PSS technique has successfully detected both the thickness of a soil-filled scour and the length of a model foundation in one survey.

C. Reverse Parallel Seismic Survey (RPSS)

It is designed to determine the depths of individual piles in a pile group (or drilled shafts in a drilled shaft group). It is based on the fact that the travel time for an elastic wave is the same if the source and detector are interchanged. This is a direct consequence of Snell's Law, and is known as the theory of reciprocity. The application of this theory to the PSS geometry is to place individual geophones near the top of each pile in a pile group. The seismic source is inserted down the instrument access hole and the survey conducted from a depth about 3 to 5 m (10 to 15 ft.) below the maximum expected depth of the piles upward to near the surface. Once the survey has been conducted, the same data analysis and criteria for depth of scour and depth to pile toes applies as for the PSS technique.

D. Pneumatic Scour Detection System (PSDS)

"Pneumatic scour detection system" for measuring scour depth around bridge foundations under flood conditions, using differential resistance to airflow through a vertical array of porous filters. The array of filters are sealed into the wall of a tubular steel piling and then battered like a large nail through the debris into the river bed adjacent to the pier. Shallow depth filters are exposed to water, intermediate depth filters are exposed to soft soil, and deeper depth filters are exposed to competent soil shows the schematics of the system. The pressure bleed -off rate of a fixed air volume versus depth will differ significantly between filters facing water versus filters sealed against soft soil versus filters sealed against competent soil [2]. At first, a scaled model was tested in a simulated environment and then installed in 2007 on a bridge over the Kilchis River near.

II. Literature Survey

Accelerometers are wide used as an instrument for dynamic phenomena for several years. These devices confirm acceleration at a given instant and that they will sample at high frequencies to supply high-resolution time histories of acceleration. The acceleration causes a celebrated mass to get a force within the device making a little current or a amendment within the current. Since the force and mass area unit celebrated, then the acceleration may be obtained by correct activity. Victimization the acceleration versus time knowledge, a displacement (or velocity) history may be obtained by numerical integration. Albeit this kind of system has been used for several years, there are a unit still problems with the error that may be propagated throughout the numerical integration (Park 2007). Recent algorithms have created the calculations additional correct, however more enhancements area unit still required. Also, these devices generate massive amounts of information, therefore intensive process is important to urge AN correct image of deflection. One perspective on the utilization of accelerometers is that they'll give helpful measurements, however because of attainable error in their use, the info ought to be ought to be supported with another form of system. for instance, some counsel that accelerometers including GPS will negate the errors that each systems could exhibit. Bridge observation is that the application of structural health observation and scrutiny techniques to bridge structures. SHM for buildings and bridges has been evolving over the past decade from ways utilized in the health observation of alternative structures. A definition of the word related to SHM is important before more discussion of the technologies used for the bridge observation. in keeping with river (1999), the goal of structural observation is to realize information of the responsibility of operational erections on a uninterrupted instant basis. Care and periodic inspections supply solely restricted information of structural condition, and these ways area unit pricey in terms of in depth labour and time period. However, advances in sensing technologies, material and structural injury characterization, and observation diagnostic technologies alter the mixing of distributed sensors for period scrutiny and injury detection[3-6].Thus, the essence of structural health observation is that the development of freelance systems for the continual observation, scrutiny and injury recognition of structures with minimum labour contribution in contrast to ancient non-destructive analysis ways, structural health observation techniques use the amendment in measurements at a similar location at 2 totally different times to spot the condition of the structure.

III. Monitoring Types

Health monitoring are often sub-divided into multiple forms of classes. each the timeframe of watching and therefore the scale of watching square measure necessary issues that require to be addressed before selecting a sort of watching system. A bridge owner might want to observe the bridge health for a amount of a year or many months, whereas in different cases solely a one-time short-run resolution is also necessary. Conversely, a replacement structure could have AN expected of fifty years and therefore the owner would love a watching system that will last AN extended period also. Relating to the size of watching, a selected joint or member during a bridge that has been problematic within the past is also the main focus of the watching. On the opposite hand, AN overall assessment of bridge response to loading is also the goal. The instant rate at that the rate of a degree during a vibratory bridge is ever-changing with time. Acceleration is that the most typical live taken to characterize vibrations. It's potential to outline the frequencies and shapes of the various modes of vibration from one acceleration trace. The frequencies and modes are often compared to values obtained from previous acceleration measurements to work out if the bridge has deteriorated or has been broken.

Climatic Conditions

Pertains to the environmental conditions within the space of the bridge which will relate to bridge performance. Parameters which will be measured include: air temperature, wind speed, wind direction, ratio, and radiation.

Curvature

The rate of modification of slope on the length of a flexural member and made by transversal loading (i.e., traditional to the longitudinal axis).From principles of structural mechanics, curvature is thought to be directly proportional to bending moment within the member.

Displacements

The overall linear movement (i.e., translation) of a bridge either in respect to its original position or on a worldwide scale. It's potential to live the displacement in one, 2 or 3 freelance directions.

Load

The total load of objects passing over a specific space of a bridge. This live are often helpful to enforce weight restrictions, additionally on outline they vary (i.e., spectrum) of typical traffic hundreds.

Tilt/Slope

The angular modification of parts during a bridge. this is often helpful in decisive distortion in bridge pure mathematics[7-9]. Slope is that the rate of modification of deflection of a flexural member with relation to length. Angle changes with relation to a vertical plane also are helpful to assess 'out-of-plumb' parts. It's helpful to grasp if there has been an outsized modification in angle on a part. Scour - the removal of soil round the piers of bridges because of fast paced water currents throughout flooding.

IV. Methodology

The current state of the aging bridge infrastructure in the around the world requires more accurate diagnostic tools for a large stock of bridges. There has been an increase in public, as well as political, awareness of the current state of the bridge infrastructure. Old and new bridges are now under public scrutiny after disastrous collapses. The current standard bridge inspection practice is based on biannual visual inspections, which are subjective by nature. Sensor-based SHM is perceived as the technology that could improve the current visual inspection process. Monitoring bridge structural systems helps in planning different bridge intervention strategies, such as maintenance actions, repair or replacement. Moreover, the life span of the bridge structure can be extended if the data shows it to be healthy. Traditional bridge SHM techniques entail the placement of sensors on the structure for measuring physical parameters that are then used as indicators of the structural behaviour. SHM and damage assessment have been very active research areas, and have motivated several excellent review and overview papers, which highlight some of the most relevant approaches describes some general and fundamental objectives for monitoring civil infrastructure and points out some historical applications. More specific review topics include wireless, structural health monitoring, design of devices, and the trend for localized processing, vibration based condition monitoring, damage identification using inverse methods, unsupervised learning, and vibration-based condition monitoring methods. Two main approaches of this type have been pursued in recent years. One is a global vibrational approach and the other is the local approach. The first looks at the vibration of the whole structure, while the latter focuses on the wave propagation along structural elements. We refer to these two approaches based on sensors placed on the structure as direct approaches. The direct approaches are especially useful when monitoring progression of damage of a particular known damage condition, or monitoring a critical member of a bridge structure.

The approach selected to solve the problem is based on a combination of a review of existing technology, development of new technology, test of functioning, and field installation and demonstration. The review of existing technology helps establish a solid foundation. The development of new technology helps progress on the field of bridge monitoring. The laboratory proof of functioning provides valuable experience for instrumentation on bridges, and leads thorough research on bridge monitors. The field installation and demonstration provides a validation of the bridge monitoring technology.

V. Module Description

A. Piezoelectric Sensor

Piezo plate works underneath electricity. This result produces an enclosed generation of electrical charge ensuing from Associate in Nursing applied mechanical force. The electrical charge that accumulates in bound solid materials is generated in response to applied mechanical stress. They'll even be used for an awfully little audio electrical device like a buzzer. Piezo plates are available handy after you have to be compelled to notice vibration or a knock. You'll be able to use these for faucet or knock sensors pretty simply by reading the voltage on the output.

The electricity may be a process in this material exhibiting the direct electricity. Piezoelectric effect is that the electrical phenomenon that accumulates in bound solid materials in response to applied mechanical stress. The electricity is that the linear mechanical device interaction between the mechanical and therefore the electrical state in crystalline materials. Piezoelectric effect is found in helpful applications, like the assembly and detection of sound, generation of high voltages, electronic frequency generation, microbalances, to drive Associate in Nursing unbearable nozzle, and ultrafine focusing of optical assemblies.

B. Arduino Uno

The Arduino/Genuino Uno may be programmed with the (Arduino package (IDE)). Choose "Arduino/Genuino Uno from the Tools > Board menu (according to the microcontroller on your board). For details, see the reference and tutorials.

The ATmega328 on the Arduino/Genuino Uno comes preprogramed with a boot loader that permits you to transfer new code to that while not the employment of Associate in Nursing external hardware computer programmer. It communicates victimization the initial STK500 protocol (reference, C header files).

You can conjointly bypass the boot loader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header victimization Arduino ISP or similar; see these directions for details.

The ATmega16U2 (or 8U2 within the rev1 and rev2 boards) computer code ASCII text file is obtainable within the Arduino repository. The ATmega16U2/8U2 is loaded with a DFU boot loader, which may be activated by:

- On Rev1 boards: connecting the solder jumper on the rear of the board (near the map of Italy) so rese within the 8U2.
- On Rev2 or later boards: there's a resistance that actuation the 8U2/16U2 HWB line to ground, creating it easier to place into DFU mode.

You can then use Atmel's FLIP package (Windows) or the DFU computer programmer (Mac OS X and Linux) to load a brand new computer code. Otherwise you will use the ISP header with Associate in nursing external computer programmer (overwriting the DFU boot loader). See this user-contributed tutorial for a lot of info.

C. Internet of things (IoT)

The internet of things (IoT) is that the network of physical devices, vehicles, buildings and different things embedded with natural philosophy, software, sensors, actuators, and network property that modify these objects to gather and exchange knowledge. In 2013 the worldwide Standards Initiative on web of Things (IoT-GSI) outlined the IoT as "the infrastructure of the data society. The IoT permits objects to be perceived and controlled remotely across existing network infrastructure, making opportunities for a lot of direct integration of the physical world into computer-based systems, and leading to improved potency, accuracy and economic profit. once IoT is increased with sensors and actuators, the technology becomes Associate in Nursing instance of the a lot of general category of cyber-physical systems, that conjointly encompasses technologies every factor is unambiguously acknowledgeable through its embedded automatic data processing system however is ready to interoperate at intervals the present web infrastructure. Consultants estimate that the IoT can include virtually fifty billion objects by 2020.

Internet of Things (IoT) is Associate in nursing setting within which objects, animals or folks area unit supplied with distinctive identifiers and therefore the ability to transfer knowledge over a network while not requiring human-to-human or human-to-computer interaction [10-15]. IoT board featured with SIM900 GPRS electronic equipment to activate web association conjointly equipped with a controller to method all input UART knowledge to GPRS based mostly on-line knowledge. Knowledge could also be updated to a selected web site or a social network.

VI. RESULTS AND CONCLUSION

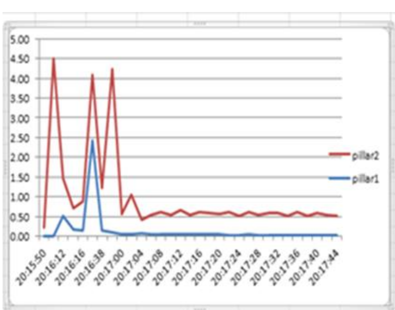

Fig. 1. Sensor reading vs. Time

- The scour is measured and graph is plotted for the sensor reading and the reading are exported to the web application.
- If the scour depth is more it indicates the weakness of bridge piers. If the bridge pier is too weak we can stop the usage of bridges, thus we can avoid the accidents.

Fig. 2. Exported output

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