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Structural Health Monitoring System for Civil Structures Based on Embedded Sensors and Advanced Networking Techniques

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ABSTRACT: Many of the civil structures like bridge and flyovers in cities are subject to deterioration as their period is terminated however, they're still in use. they're dangerous to bridge users. because of significant load of vehicles bridges might get collapse that successively results in disaster. So, these bridges need continuous observance. So, we tend to proposing a system that consists of a Load sensing element, Flux sensor, Vibration sensor, IR Sensor, Wi-Fi module, and Arduino microcontroller. this technique detects the load of vehicles, bending of bridge, and vibration. If the vibration, bending of bridge, vehicle count and vehicle load on the bridge cross its threshold price then it generates the alert through buzzer and auto barrier. If it necessary, then the admin assign the task to the staff for maintenance. The communication between admin and observance system is achieved mistreatment IOT. A webapp are designed and updated with the information collected by the sensors for future data analytics.

KEYWORDS: IOT, Arduino, Sensors, Wi-Fi.

I. INTRODUCTION

Bridges and flyovers are important in several regions, being used over many decades. it's important to possess a system to watch the health of those bridges and report once and wherever maintenance operations are required. Advancements in sensing element technology have brought the automatic period of time bridge health watching system. several long span bridges in Korea and in Japan have adopted this period of time health watching system. However, current system uses difficult and high price wired network amongst sensors within the bridge and high price optical cable between the bridge and therefore the management centre, that will increase the general price of installation and maintenance price of health watching system. The difficult wiring additionally makes the installation and repair/replacement method tough and expensive. during this project a concept of bridge health observation system using wireless is planned. for brief distance (among sensors within the bridge) internet is employed as wireless network, and webapp is employed for long distance (between the bridge and therefore the management centre) electronic communication. This technology is known as MBM (monitoring-based maintenance) that allows the bridge maintenance engineers monitor the condition of the bridge in real time. The sensors put in on varied components of the bridge monitors the bend, traffic, weight of the vehicles etc. At any point of time if any of those parameters cross their threshold worth the communication system informs the management centre giving an alarm for taking preventative measures. the entire parameters of the bridge are taken by associate Arduino microcontroller and sent to a different module that is found in a very short distance. Here the communication established is using internet that uses wireless transmitter and receiver electronic equipment. The receiver module takes the parameters from the transmitter and sends a message with all the parameters to a database centre. The communication established between the intermediate module and therefore the database centre is using webapp technology.

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II. OBJECTIVES

1 Monitor the traffic in the bridge.
2. Monitor the load in the bridge.
3. Indicates when there are earthquakes, cracks and bending in the bridges.
4. Design of Bridge monitoring system.
5. Analysis of bends, cracks and loads are done.
6. Implementation of IR sensor, Load sensor, Flex sensor, Vibrator sensor, stepper motor.

III. PROBLEM SUMMARY

Flyovers and route bridge systems are important in several regions, being employed over many decades. it's important to own a system to observe the health of those bridges and report once and wherever maintenance operations ar required. Advancements in sensor technology have brought the automated real-time bridge health observation system.

However, current system uses difficult and high price wired network amongst sensors within the bridge and high price optical cable between the bridge and also the management centre. The difficult wiring additionally makes the installation and repair/replacement method troublesome and dearly-won. In this project a plan of bridge observation system victimisation wireless is planned. for brief distance (among sensors within the bridge) internet is employed as wireless network, and webapp is employed for long distance (between the bridge and also the management centre) electronic communication. This technology will be known as MBM (Monitoring based mostly Maintenance) that permits the bridge maintenance engineers monitor the condition of the bridge in real time. The sensors put in on numerous elements of the bridge monitors the bend, traffic, weight of the vehicles etc. At instance time, if any of those parameters cross their threshold price the communication system informs the management centre giving an alarm for taking preventive measures.

IV. PROPOSED SYSTEM

The sensors are installed on various parts of the bridge as shown in the above system block diagram, monitors the bend, traffic, weight of the vehicles etc. At any point of time if any of these parameters cross their threshold value the communication system informs the management centre giving an alarm for taking precautionary measures. The complete parameters of the bridge are taken by a Arduino microcontroller and sent to another module which is located in a short distance. Here the communication established is using internet that uses wireless Transmitter and Receiver circuitry. The receiver module takes the parameters from the transmitter and sends a message with all the parameters to a database centre. The communication established between the intermediate module and the database centre is using webapp technology. The sensory inputs are process to represent the condition of the bridge against seismic loads, loads etc. The receiver module takes the parameters from the transmitter and sends a message with all the parameters to a database centre. The communication established between the intermediate module and the database centre is using webapp technology.

When the system is powered up, there will be a display of Output of the Sensors on LCD. Also, the information is sent to the monitoring house using internet. Then the webapp initialization takes place and it searches for the signal. As the webapp initialization is completed, there will be a constant monitoring of flex sensor and the digital output value is displayed in the LCD, at the entrance of the bridge.

There is an IR sensor at the entry of the bridge, which detects the vehicle and gives the incremented count of the number of vehicles on the bridge. If the number of vehicles exceeds the threshold value (i.e., 20), the gate is closed. There is an IR sensor at the exit of the bridge, which detects the vehicle and gives the decremented count of the number of vehicles on the bridge. The gate is opened if the number of vehicles is equal to 19 or less. If the monitoring head wants to know the number of vehicles on the bridge, he gets the same by using the webapp.

There is a vibrator sensor at the bottom of the bridge, which detects the earthquakes (heavy vibrations). The gate is closed when there are heavy vibrations. the information is sent to the monitoring house using internet and the monitoring head using webapp.

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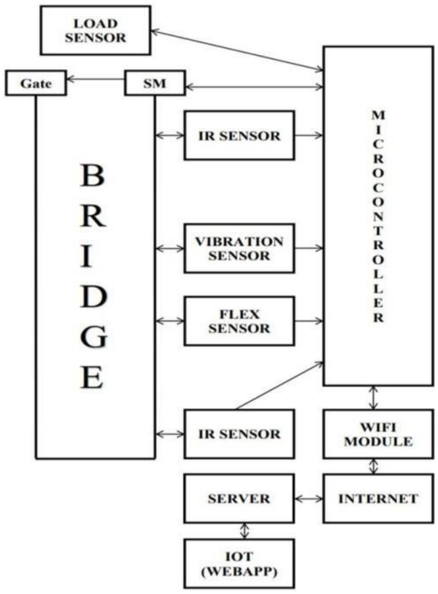
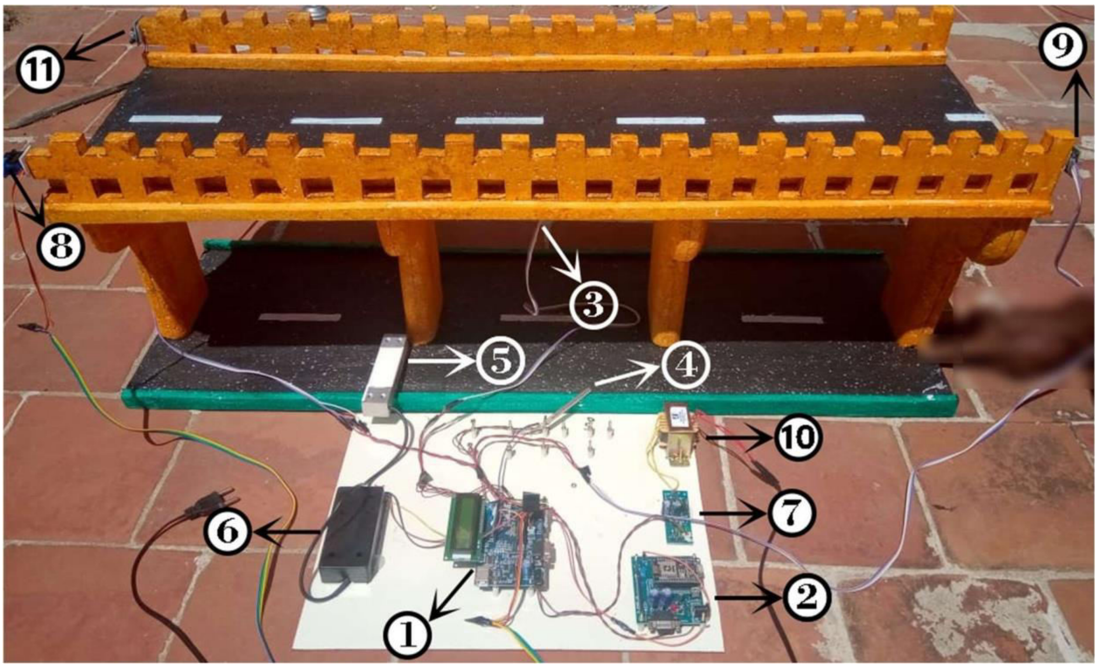


There is a flex sensor beneath the bridge, which detects the cracks and bending. The gate is closed when the threshold value of flex exceeds 310. The information is sent to the monitoring house using webapp.

There is a load sensor at the entry of the bridge, which detects the load on the bridge. The gate is closed when there are heavy loads. The information is sent to the monitoring using webapp. The entire collection of data can be monitored in webapp of the monitoring system. The gate is operated by using a stepper motor. The entire automation process is archived by using Arduino microcontroller.

IV. RESULT AND HARDWARE DESCRIPTION

OVERVIEW OF HARDWARE



The Components of Hardware

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The Hardware Components are listed below:

1. Arduino UNO Microcontroller & LCD Display
2. WIFI Module
3. Vibration Sensor
4. Flex Sensor
5. Load Sensor
6. Load Sensor Driver
7. Rectifier
8. Stepper Motor
9. IR Sensor OUT
10. Transformer
11. IR Sensor IN

STEPS TO VIEW RESULT

Front View of Hardware

Side View of Hardware

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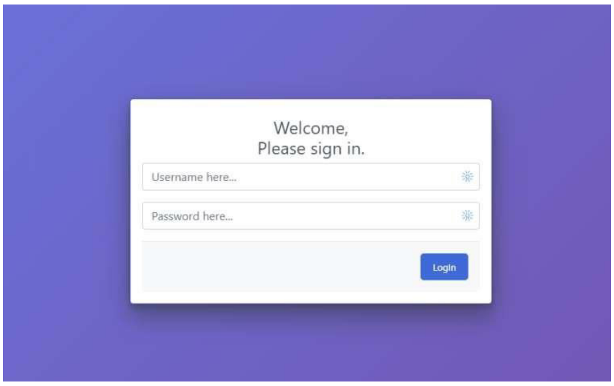
Fig

1) Visit: http://www.iotclouddata.com/20log/352/index.php



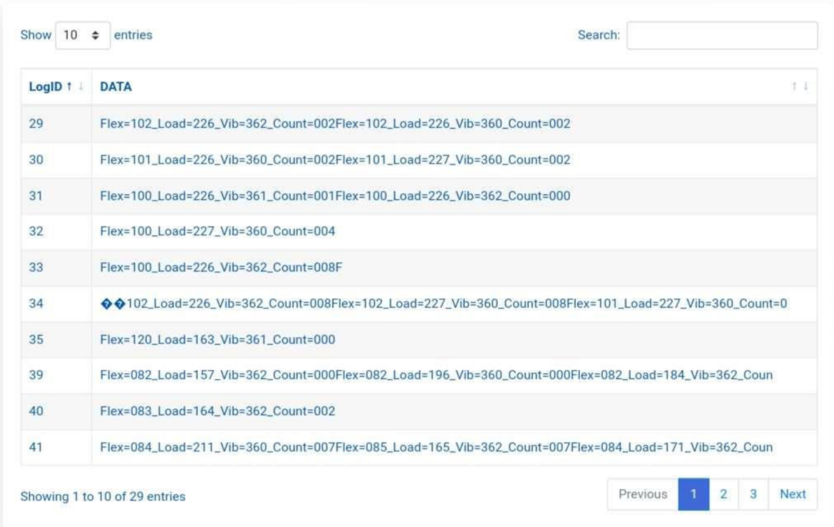
Login Page

2) Enter Credentials

Username : admin

Password : admin

3) Login



Show 10 entries Search:

LogID	DATA
29	Flex=102_Load=226_Vib=362_Count=002Flex=102_Load=226_Vib=360_Count=002
30	Flex=101_Load=226_Vib=360_Count=002Flex=101_Load=227_Vib=360_Count=002
31	Flex=100_Load=226_Vib=361_Count=001Flex=100_Load=226_Vib=362_Count=000
32	Flex=100_Load=227_Vib=360_Count=004
33	Flex=100_Load=226_Vib=362_Count=008F
34	��102_Load=226_Vib=362_Count=008Flex=102_Load=227_Vib=360_Count=008Flex=101_Load=227_Vib=360_Count=0
35	Flex=120_Load=163_Vib=361_Count=000
39	Flex=082_Load=157_Vib=362_Count=000Flex=082_Load=196_Vib=360_Count=000Flex=082_Load=184_Vib=362_Coun
40	Flex=083_Load=164_Vib=362_Count=002
41	Flex=084_Load=211_Vib=360_Count=007Flex=085_Load=165_Vib=362_Count=007Flex=084_Load=171_Vib=362_Coun

Showing 1 to 10 of 29 entries Previous 1 2 3 Next

Reading Page

OUTPUT ANALYSIS

FLEX SENSOR (BEND SENSOR)

Flex Sensor shows the amount of bending happens in the bridge. In the LCD display the Letter "F" denotes the Flex Sensor Output.

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When the bridge is subjected to no load, the Flex sensors provides an output of F059

Initial bending of the bridge

When the bridge is subjected to load, the Flex sensors provides an output of F093

Bending of the bridge when user uses the bridge.

VIBRATION SENSOR

Vibration Sensor senses the intensity of vibration occurs in the bridge. In the LCD display the Letter "V" denotes the Vibration Sensor Output.

When the bridge is subjected to no load, the vibration sensor provides an output of V096.

Vibration of the bridge without any vehicles.

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When the bridge is subjected to load, the vibration sensor provides an output of V362.

Vibration of the bridge while users using the bridge.

IR SENSOR
IR Sensor counts the number of vehicles using the Bridge.
In the LCD display the Letter "C" denotes the IR Sensor Output.
When the bridge is subjected to no load, the IR sensor provides an output of C000.

Initial Vehicle Count

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When the bridge is subjected to load, the IR sensor provides an output of C003.

Number of vehicles uses the bridge.

LOAD SENSOR
Load Sensor senses the load of the bridge
In the LCD display the Letter "L" denotes the Load Sensor Output.
When the bridge is subjected to no load, the load sensor provides an output of L180.

Initial load of the bridge.

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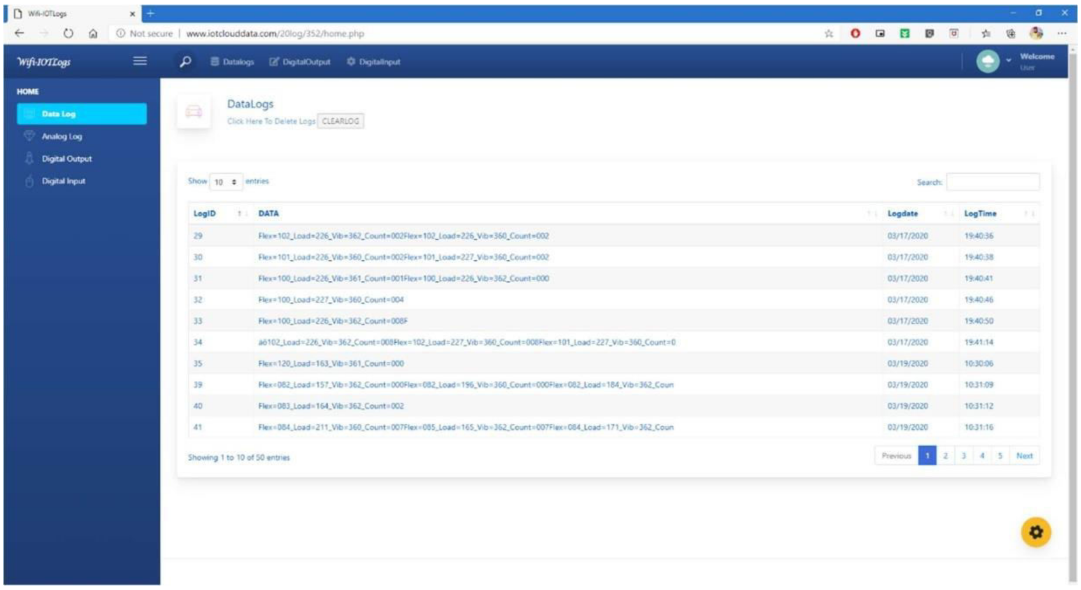
When the bridge is subjected to load, the load sensor provides an output of L202.

Load of the bridge, when user uses the bridge.

IOT OUTPUT

The Webapp shows the data collected by the monitoring system

Desktop View



Desktop View

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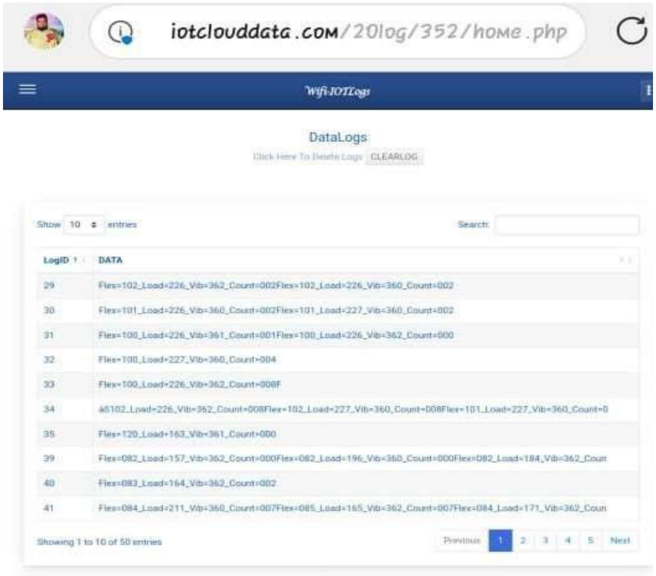
Mobile View



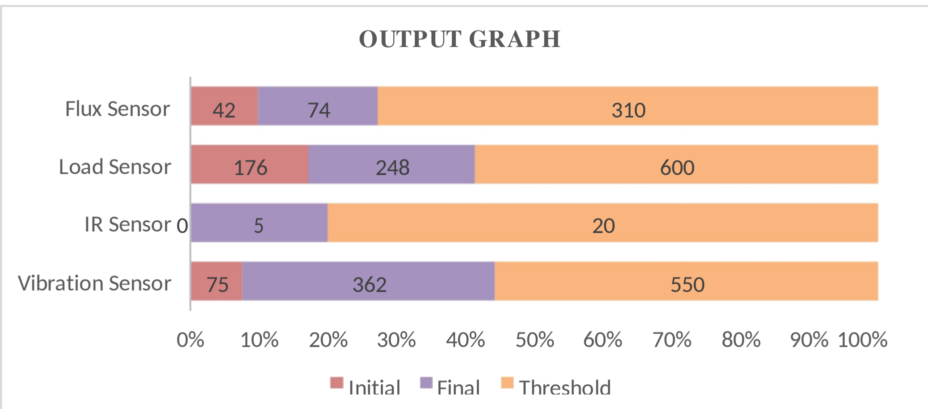
Mobile View

OUTPUT TABULAR

SENSORS	INITIAL	FINAL	THRESHOLD
Flex Sensor	42	74	310
Vibration Sensor	75	362	550
IR Sensor	0	5	20
Load Sensor	176	248	600

Output Table

OUTPUT GRAPH



Output Graph

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IV. CONCLUSION

Structural health monitoring system for civil structures based on embedded sensors and advanced networking techniques, to alert and analyse using IOT when there is a change in physical structure in the bridge This system will help to reduce big disasters in future. This system can save the lives of many people. This system can help in monitoring the bridge in an efficient, cost effective and reliable manner. The immediacy, low cost, low energy and compact size add up to a revolution in bridge safety monitoring, providing a heightened level of early-warning capability.

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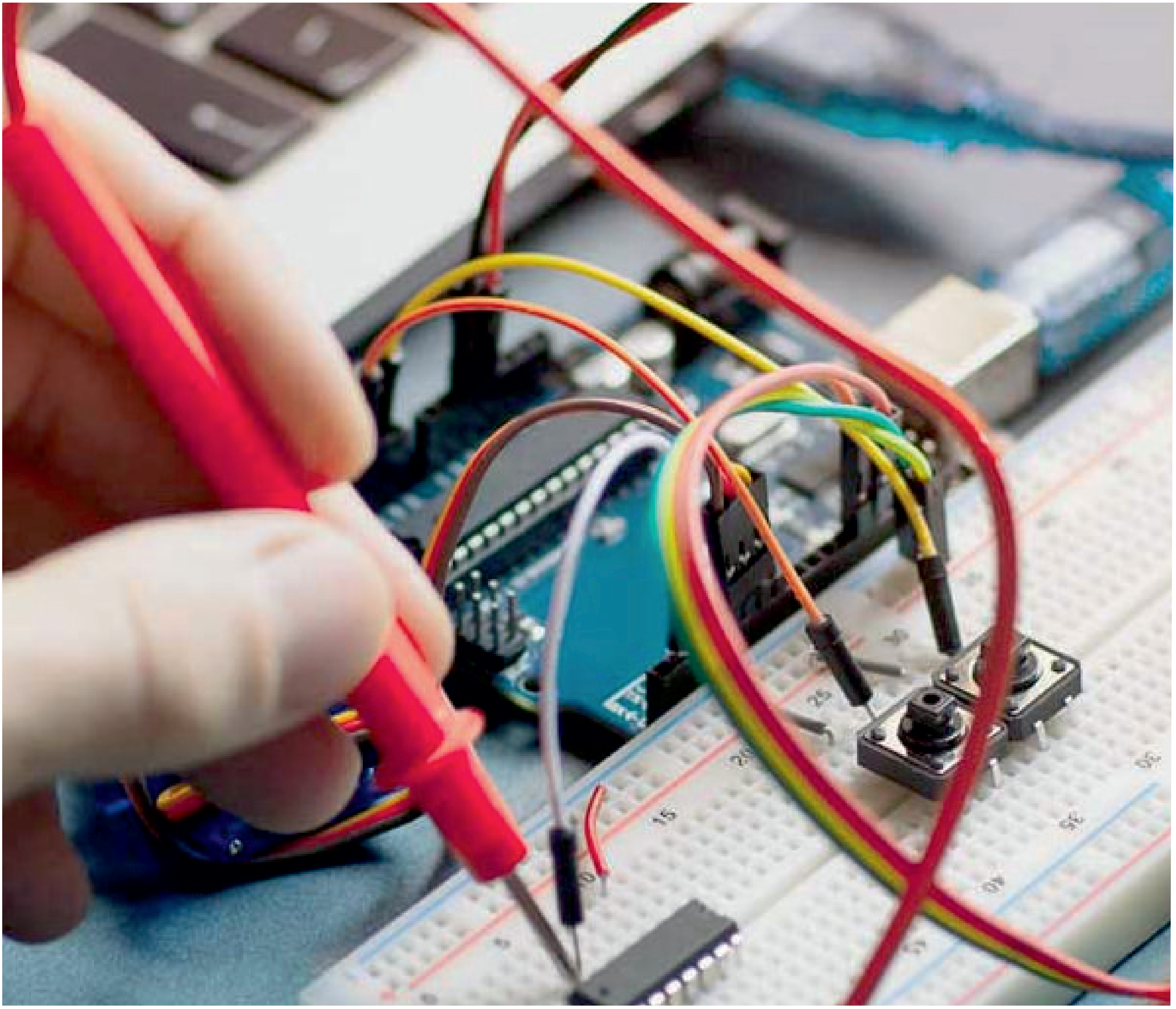

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