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Nagu Sathappan AWeldI is a final year NSIRC PhD student of London South Bank University, based at TWI. She graduated from Anna University, India with a Bachelor's in Production Engineering & Master's in Engineering Design. Having research experience in the field of non-destructive testing (NDT) from IITM motivated her to make this contribution to society. She still takes great pride in serving the teaching profession and empowering young minds. She is incredibly proud in submitting this abstract with the aid of four men who have been her strong pillars of support, including her father and supervisors.

Application of RFID Device for Underwater GMR Sensor Data Storage

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I. INTRODUCTION

In the underwater sector, the use of wireless sensors offers a lot of potential for monitoring the health of rivers and oceans [1]. Humans find it difficult and expensive to detect corrosion in pipes under water: A Remotely Operated Vehicle (ROV) may carry a variety of inspection instruments and record a vast amount of data from on-board sensors [2]. Existing terrestrial wireless sensor network solutions have relied on electromagnetic waves for communication. RFID readers can scan many tags at once and it is omnidirectional whereas Fibre optics is unidirectional [2]. RFID tags are mostly used to identify physical things, and they contain an Electronic Product Code (EPC) [2]. A unique technological solution was investigated in this situation in order to allow the device to function effectively even when submerged.

A Non Destructive Testing tecnique, Magnetic Flux Leakage Testing, involves the use of magnetic circuit (AlNiCo magnet,pipe sample and GMR sensor) where magnetic flux flows through the sample. MFL is widely used in NDT for corrosion monitoring. This paper presents the development of a device to collect and store data from a giant magnetoresistance (GMR) sensor for underwater corrosion monitoring using RFID. The findings show that RFID systems can be used to store data at near ranges regardless of frequency. This paper also provides an investigation into RFID, transponders, and reader classification, as well as existing applications underwater and their benefits.

II. DESIGN/METHODOLOGY/APPROACH

RFID technology is more efficient than other RF approaches when a greater read range, rapid scanning, and diverse data carrying capability are required. An RFID system consists of a transponder and a reader. There are three types of transponders: active, semi-active, and passive tags.

The two main frequencies used by active RFID systems are 433 MHz and 2.5 GHz. Semi active tags combine the advantages of both active and

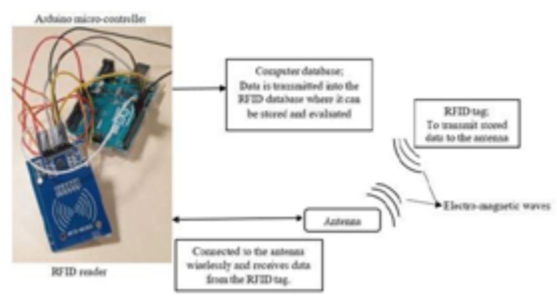

Figure 1. RFID system

passive tags [3]. Unlike active tags, an RFID reader sends a signal to passive tags. The reader sends energy to the transponder's antenna, which transforms it into an RF wave that is sent into the reader's range. A passive tag is powered by the reader, whereas active and semi-passive tags require battery charging [1].

It gives the tag its strength, which fuels the tag's circuits. When the coiled antenna inside a passive RFID tag comes into contact with radio waves from the RFID reader, it generates a magnetic field, and the reader controls the tag [1].

The correspondence between an RFID reader and a tag is controlled by these requirements.

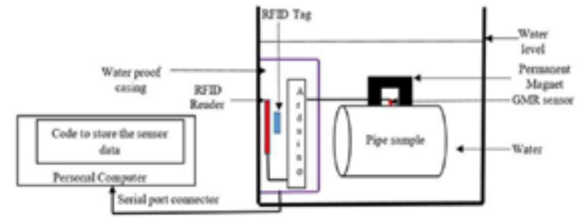

Figure 2: Experimental setup for storing the sensor data in the RFID rewritable tag

III. FINDINGS/RESULTS

The specifications of the equipment used are RFID Reader/writer, Tag – MFRC 522. Frequencies used in RFID applications includes 125 KHz, 13.56 MHz and 860-930 MHz for passive RFID [3];

Because of the reduced reading range, high-frequency systems operating at 13.56 MHz have certain drawbacks.

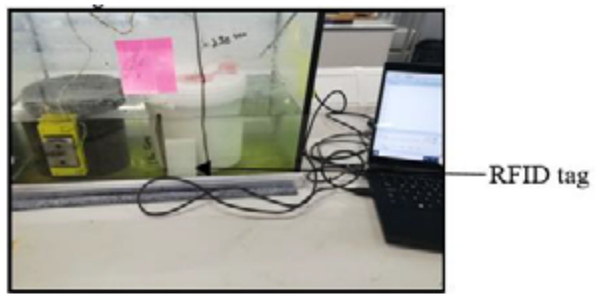

Figure 3. Magnetic circuit immersed in water along with RFID system

The magnetic circuit was immersed in the tank filled with water along with the RFID system, which comprises of Arduino microcontroller connected to the reader. The tag was placed close to it, all together inside a waterproof casing as in Figure 2. The Arduino microcontroller was connected to the laptop through a serial port connector. By running the code, the data from the GMR sensor was collected through the RFID system. Thus, the sensor data goes via the Arduino micro-controller to a writable RFID tag, and the reader reads this and sends to the PC as in Figure 3.

Table 1.Measurement ranges of 125 kHz and 13.56 MHz frequency transponders at different conditions

Tag-type	Frequency	Air	Fresh water	Salt water
PPS + Epoxy	125 kHz	10 cm	5 cm	3 cm
ABS	125 kHz	55 cm	53 cm	51 cm
Nylon	125 kHz	46 cm	42 cm	41 cm
PVC disc	125kHz	49 cm	36 cm	33 cm
Plastic	13.56 MHZ	12 cm	5 cm	4 cm

The maximum range obtained using RFID readable transponder at air is 55cm with ABS at 125 kHz and for salt water it is 51 cm. For 13.56 MHz frequency,the range obtained is 12 cm at air and 4 cm under saltwater.

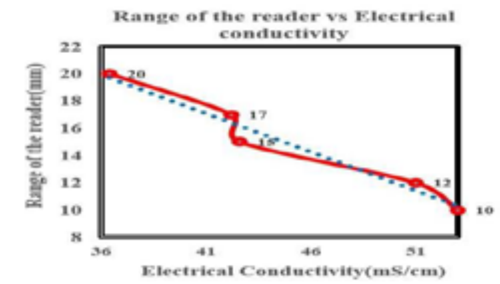

Figure 4. Range of the reader vs Electrical Conductivity for varying salinity level of water

Salinity level of water was slowly increased and the electrical conductivity was measured accordingly.

Range decreases with increase in electrical conductivity, as in Figure 4, due to the salinity level in water where it absorbs more electricity.

IV. DISCUSSION/CONCLUSIONS

A method to gather and store the data sent by the GMR sensor is required. RFID system provides data accuracy. The data sent by the GMR sensor must be stored in order to detect corrosion and reduction in wall thickness as it holds more sensitivity. The RFID system assures data integrity while also cutting down the time it takes to complete tasks. Each RFID tag has a different memory capacity.

The development of RFID sensor measurement has been presented and evaluated for underwater data collection. The findings show that RFID systems can be used to store data at near ranges regardless of frequency. The experimental investigations show satisfactory results in terms of data collection from the magnetic circuit for a 2mm thickness pipe sample.

V. FUTURE PLAN/DIRECTION

The system has been developed for data storage with a single RFID tag whereas testing can be carried out with multiple tags as well. Multiple RFID systems can be used for collection of data at various ranges within the reader, and this will be a subject of future research. However, the ability to use lower frequency bands has led to the advancement of certain RFID applications for particular purposes in both marine and freshwater environments.

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