

An Integration of Inductive Sensors and Development of Android based Application

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Abstract - In many technical goods and systems, inductive proximity sensors are employed for the contactless sensing of object or target displacement and location. They are used in many different application areas, including security, telecommunication, robots, transportation, and manufacturing lines. An Ethernet-enabled PLC receives input from inductive sensors, such as electromagnetic, magnetic, and capacitive sensors. The data logger, which has a sensor to collect the data and a computer chip to store it, receives the output. After that, a computer is used to analyze the data that was recorded in the data logger. If the device is within communication range of the wireless data logger system, it can send the data straight to the end user.

Key Words: Electromagnetic Sensors, Magnetic Sensors, Capacitance Sensors, Twin CAT, OPC Server, API

1. INTRODUCTION

An inductive sensor may be a device that uses the principle of electromagnetic induction to detect the objects. An inductor develop a magnetic flux around it when a current passes through it; alternatively, a current will flow through a circuit contain an inductor when the magnetic flux apply it changes. An electrical proximity sensor that doesn't require contact is called an inductive one. It is employed for metal item recognition and positioning. The kind of metal being detected determines the inductive switch's detecting range. A greater sensing range is possible with ferrous metals like steel and iron, however nonferrous metals like copper and aluminum can cut the sensing range by as much as 60%. An inductive sensor is sometimes called an inductive proximity switch because its output might be in one of two states. Inductive sensors are widely used in automated industrial processes, traffic lights, car washes, and metal detectors. The sensor is especially helpful in situations where access is difficult or when there is a lot of dirt because it doesn't require personal contact. An induction loop or detector coil makes up the sensor. Typically, this involves a coil form or ferrite ceramic rod with a high magnetic permeability core coiled around a number of turns of insulated magnet wire. The winding may or may not have a feedback tap a certain number of turns from one end of the overall winding. It is joined with a capacitance to create a circuit for a tuned frequency oscillator tank. This creates a tuned frequency oscillator when

combined with an operational amplifier or transistor, which is a voltage or current gain device.

2. TYPES OF INDUCTIVE SENSOR

There are three vital sorts of inductive sensors: Electromagnetic, Capacitance and Magnetic. Each sensor has its individual potentiality and can be used in different ways.

2.1 Electromagnetic

Electromagnetic Induction or Induction is a procedure in which a conductor is establish in a exacting location and magnetic field keeps unstable or immobile and the conductor is moving. This will produce Voltage across the electrical conductor. It has the ability to detect electrons, photons, magnetic fields, etc. is considered an electromagnetic sensor. It can be as new as a charge-coupled gadget, or as old as a white wall, sheet of white paper, etc. An electronic device that measures a physical quantity, such loudness or pressure, and transforms it into an electronic signal

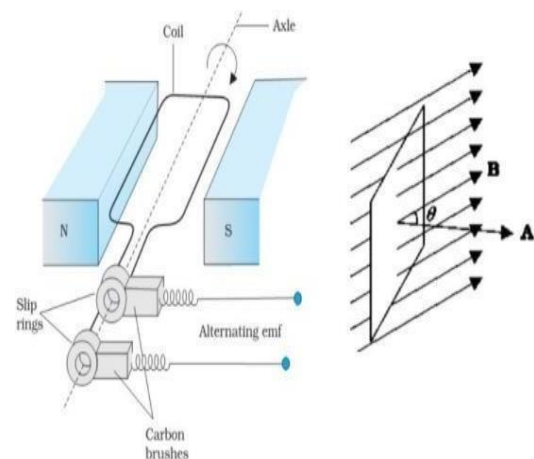


Fig- 1: Electromagnetic Sensor

2.2 Magnetic

Magnetic Induction Sensor is composed of the magnetic substance that moves in the adaptation circuit, the first is winding coil, the second is winding coil, and the coil. The exchange in the magnetic field is generated by stimulating the

first winding coil by the first exchange signal that becomes a usual. Because the magnetic substance moves in the winding coil arranged at the position is obtained. A miniature micro electro mechanical systems (MEMS) device for magnetic field detection and measurement is called a magnetometer or MEMS magnetic field sensor. Many of them work by detecting Lorentz force effects; for example, an optical measurement of a mechanical displacement can be made, or an electronic measurement of a change in voltage or resonant frequency. It is vital to account for the impacts of temperature. Using it as a miniature compass could be one such easy example use.

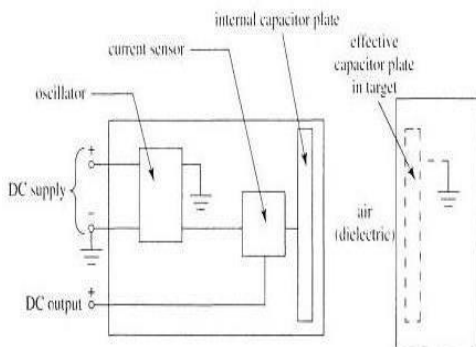


Fig-2: Magnetic Sensor

2.3 Capacitance

A capacitive sensor is an electronic device that uses no physical contact to detect targets such as liquids or solids. The capacitive sensor's detecting end will generate an electrical field in order to identify these targets. This sensor can identify any object that can disrupt the electrical field. Capacitance type of sensors uses an electric field, in order to be sense by an inductive sensor of an object must be conductive. A capacitance sensor will respond to an objective which act as a dielectric medium. One kind of proximity sensor that uses the electrical field effect created by the sensor to identify items in close proximity is the capacitor sensor. The ability of these sensors to detect conductive materials while looking through insulating materials like plastic or wood is comparable to that of radar.

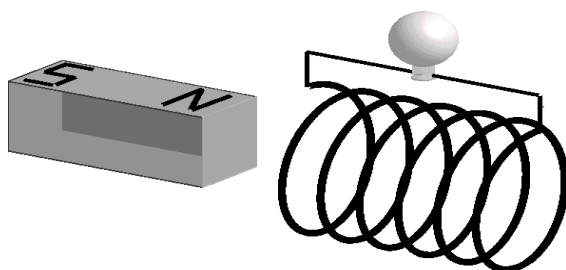


Fig- 3: Capacitance

3. LITERATURE SURVEY

Rocher et al. [1] Displays the benefits of the similar type of sensor that is used for monitoring the water level inside the pipes. In this paper, the sensor is used to observe the

destructions and leakage inside the pipe over the network. These sensor includes two coils, one is PC and another one is IC, that are coiled over the PVC with the 20mm of the diameter. They verified different prototypes coils in different form and with the various number of spires. They concluded that the prototype containing 55 spires is best in the performance.

Radchenko et al. [2] "Design and Evaluation of Low-Cost and Energy-Efficient Magnetic Inductive Sensor Nodes for Wireless Sensor Networks". A set of low cost and energy efficient sensor are intended and implement using magnetic induction communications for wireless networks, which are especially well suited for underground water and underground networks where the predictable mode of communication does not perform well.

Yang Tao et al. [3] "A Novel Approach to Measuring Separation Process of Oil-Saline Using Differential Electromagnetic Inductive Sensor and FPGA-Based Impedance Analyzer". This paper implements a novel string system acquiring a various electromagnetic inductive sensor based on the analyzer of the impedance to observe the separation of the oil-in saline liquid system. These inductive sensor has arranged in a concentric cylinder manner, where its coils are arranged distinctive. This can be achieved by homogenous sensing region.

Ascension Lopez-Vargas et al [4] "On the application of IoT for real-time monitoring of small stand-alone PV systems: Results from a new smart data logger". The integration of Internet of Things in solar measurement systems allow the monitor of minute off grid photovoltaic (PV) systems, enhancing the routine and the maintenance of the system. The proposed smart logger is capable of acquiring the values for electrical parameters, offering information

4. METHODOLOGY

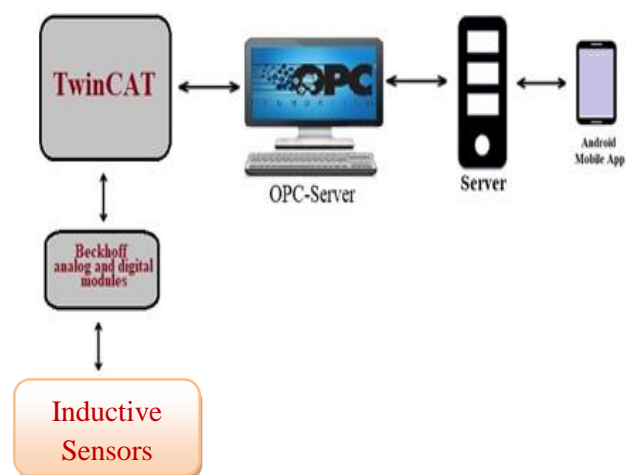


Fig-4: Architecture Diagram

Figure 4, depicts the system architecture, the Inductive sensors are connected to Beck off analog and digital modules, once the wiring connection is done it is then directly connected to PC using an Ethernet cable. In the Twin CAT a project is created and a ladder logic programming is done for specific sensors application, and the program must be compiled without any errors. There will be a bidirectional communication between Twin CAT and OPC server, which will fetch the tags using native protocols then the data will be sent to server. With the help of developed Mobile application using API the data will be fetched and display the working of Inductive sensors on mobile screen.

4.1 Module 1

Project Creation and Configuration of PC based System

- In order to generate the project, open the menu, select new project to design a new Twin CAT project source file. A new project folder with the Twin CAT project opens in the solution explorer in visual studio.
- Within the solution explorer choose the PLC node and then select Add New Item, to add a Twin CAT project.
- Within the categorization templates select the standard project template.
- Enter the project name and mention path location for the desired project and press the Add button.
- For adding objects open project, select an entry in the project tree, for example the folder POU's. Select the command put in the menu.
- Depending upon the entry selected in the tree, Twin CAT offers suitable objects for selection. Object POU: Object Method, Object Property, Object Action, Object Transition, etc.
- To configure Twin CAT project, do general project-independent settings for the behavior of editors and general project settings.

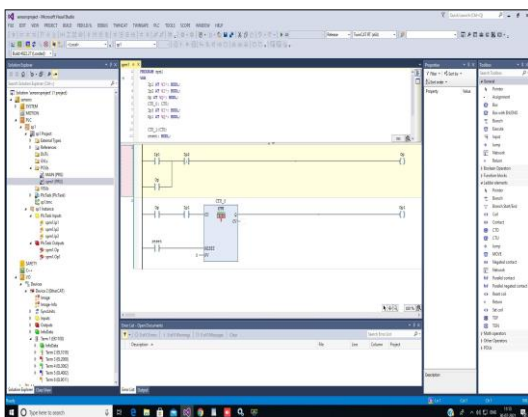


Fig-5: Ladder logic programming

4.2 Module 2

OPC Configuration:

- Configure the variables for the OPC UA access.
- Establish the download of the symbol file
- Activate the license for the server
- Turn on the project
- Found out a connection to the OPC UA Server

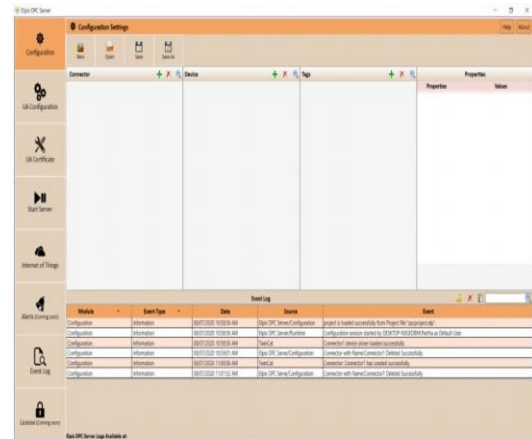


Fig-6: OPC Configuration

Figure 6, shows the OPC configuration setup page. Click on in connector to add connector then select connector type as Twin CAT. Click on save. After successful connector creation the details of the required Twin Cat project is added.

4.3 Module 3

Hydac Configuration:

- After successful login to the Hydac website <http://192.168.5.143:1024/HYDAC/>.
- A new project is created by selecting lab-IPC and category Twin cat that currently using.
- Then need to select the type of port such as digital output configuration, analog input/output configuration port.
- Make sure system configuration is setup properly.
- Once lab and category is selected you will see IPC configuration.
- Enter twin cat project and variable name with "." in between.
- Enter valid address.
- Enter value and click on submit.
- User will able to see an experiment data in table.

- It will display the data when the object is detected by the sensor.
- For further purpose these data can also be downloaded.

4.4 Module 4

Sending Data to Server:

- Twin CAT and OPC server runs on the same engineering station.
- OPC UA (Unified Architecture) services need to be configured in the engineering station.
- The configured services need to be started.
- The data is sent to the server through TCP/IP protocols.

4.5 Module 5

Displaying the Data on Mobile Application:

APIs allow applications to access a huge range of data. In numerous cases, developers usually connect their software to third party APIs. By this it enables to save a significant amount of time.

5. RESULT AND DISCUSSION

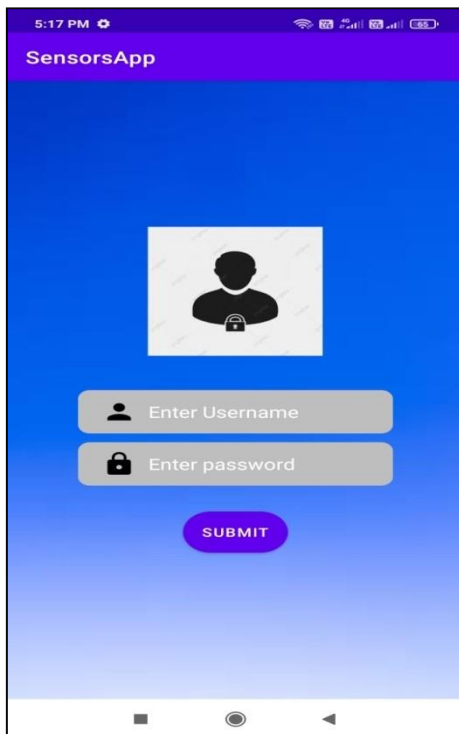


Fig -7: Login page

In the Android application, it consists of Login Page as shown in the Fig 7 which consists of Username and Password for login. An authenticate user have to input correct

Username and password, if it is not correct then the login will be unsuccessful, if it is correct means the login will be successful and will leads to next page in the mobile screen. The next page will display the list of labs that are available in a company. Here user can select their respective labs and can proceed for next page in the mobile application. Then the list of assets will be visible to the users; they can select their device for their project. Finally it will display the data of the Inductive sensors status as shown in the Fig 10. After that user needs to enter the type of port that is required for the sensors, in which this leads to new page activity showing the details of address, value and prepared value. When an object is detected this prepared value will be true, initially all the values will be false until the object is detected.



Fig -8: Experiment Data

6. Conclusion

The OPC plays an essential role in the field of measurement, monitoring and automation, enabling system integration for both hardware and software. The input inductive sensor are taken into PLC program is developed in PLC using TwinCAT3 , based on the program stored in the memory outputs are generated and sent into TwinCAT3, software make it easy for server to collect data from an Ethernet cable.

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