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Integration of all types of Photoelectric Sensors with IoT and Development of Android Based Application

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Abstract - *As the manufacturing world become more and more automated, industrial sensors have turned out to be the key to increase in both productivity and safety. Photoelectric sensor is equipment designed to detect the distance, absence, or presence of an object. The application of Photoelectric Sensors is more wide-ranging in industrial manufacturing. Sensors such as thru beam, retro reflective and diffused sensors are taken as input to an Twin CAT software system a project is created and programmed using ladder logic then the outcome will be fetched by OPC server which has a bidirectional communication with Twin CAT. Then obtained data will be sent to server through TCP/IP protocols. With the help of developed Mobile application using API can communicate with server to receive the data and display the working of photoelectric sensors on the screen which makes the work easier and faster.*

Key Words: Thru Beam Sensors, Retro reflective Sensors, Diffused Sensors, Twin CAT, OPC Server, API

1. INTRODUCTION

Photoelectric sensors are extensively used in the industrial manufacturing region as they offer an enormous sort of trouble solving alternative in the industrial sensor market. Photoelectric technology has vastly developed a lot and sensor is now capable of detecting an object less than 1 mm in diameter. Photoelectric Sensors not just notice the targets but also the variance in grounding state, and further article by a number of collections of visual attributes. A Photoelectric Sensors corresponds mainly an emitter for emitting light and a receiver for receiving the light. When an ejected ray is cut in by the target, it modifies the quantity of light ray that gets in at the Receiver. The Receiver will detect this occurrence and convert it to an electrical output. The light ray for the bulk of Photoelectric Sensors is infrared or visible light. The Photoelectric Sensors come in different housing styles, types, and sizes; therefore it can be adapted to manufacturing necessity. The applications of Photoelectric Sensors are in Food and Beverage Industry, Automotive Industry, Material Handling, Machine Engineering, Pharmaceutical Industry, Door, and Gates.

2. TYPES OF PHOTOELECTRIC SENSORS

There are three vital sorts of photoelectric sensors: thru-beam, retro reflective, and diffused. Each sensor has its individual potentiality and can be used in different ways.

2.1 Thru Beam

In Thru-Beam sensors the Emitter and the Receiver are housed in different cases that are separated from each other in order to make possible the ray from Emitter to get into the Receiver. When a sensing item or target move in the middle of emitter and receiver it will interrupt the ejected ray which will cut down the quantity of ray that get into the Receiver. The amount of reduce in light intense level is used to detect the target. It is also known as opposed mode is the most efficient sensing mode which ends up within the longest sensing range. This high gain enables thru-beam sensors to be consistently used in foggy, dusty and dirty environments. The benefit of working with thru-beam sensor is that it is the best reliable sort of sensor and has the longest sensing range of the other three. Thru-beam sensors are the foremost reliable sensing mode for accurate parts counting within the manufacturing industry. The well-defined beam and precision enable accurate parts counting, because as the parts are large enough to screen the entire beam. Thru-beam sensors are also the best selection when using them in a dirty environment because most other photoelectric modes aren't suitable for dirty environments. In case they used means it requires more care and regular cleansing. It is important to undergo that there should be minimum two parts is required to install in order to make this work perfectly. Fig 1 shows the working of thru beam sensors.

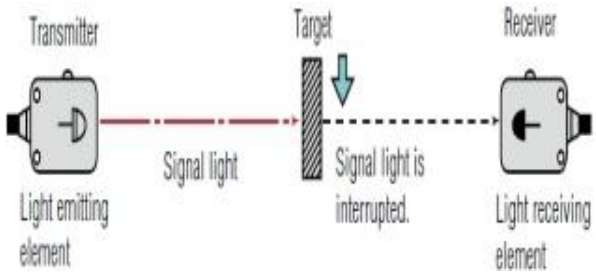

Fig-1: Thru-Beam Sensors

2.2 Retro reflective

In retro reflective sensor, both the light source and the receiving device are set up in the same casing. The sensor projects in sequence with a reflector. The light ray ejected from the sensor points toward the reflector, which is then carry back to the light receiving section. The sensor recognizes the existence of the target when light ray is break up. The transparent target recognize sensor is a unique retro-reflective mode photoelectric sensor that recognize clear targets, regular retro-reflective sensors may not. By the utilization of a low hysteresis circuit, the sensor will recognize little modification in light typically when sensing clear targets. The clear target recognizer makes use of contrasted filters on both side of the transmitter and receiver of the sensor to scale back faulty reaction raised by reflections from the target. Retro reflective is a cheaper one and somewhat less accurate when compared to thru-beam sensors. While working with plain or glassy products, retro reflective sensors are the foremost choice for example with glass and plastic bottle object identification is easy. Another advantage is that retro reflective sensors only required to be wired on one side. Some of the applications are sanitization chamber, entry gates. Fig 2 shows the working of retro reflective sensors.

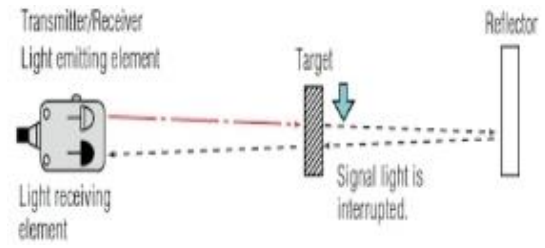

Fig-2: Retro reflective Sensors

2.3 Diffused

In Diffused sensing the Emitter and Receiver are placed in the single casing and light usually don't come back to the Receiver. The light ray from the emitter hit the sensing target, the target reflects the light and it move into the receiver where the magnitude of light is raised, raise in light intensity is utilized to recognize target. Diffused sensors with background suppression sensors have an outlined sensing extent for some target irrespective of color, reflectivity or finish. They are capable to notice the dark objects arranged on glassy conditions and can be well positioned and focused. The disadvantage of diffused sensors are they are not so much reliable when utilized in spot or state recognizing compared to thru-beam and retro reflective sensors and they aren't as efficient on clear objects. These sensors are actually foremost work on by the color shade, appearance, the angle of incidents, object characteristics, and dirty environments. Some of the applications are color mark/print mark or contrast sensors, luminescence sensors, color sensors. Fig 3 shows the working of diffused sensors.

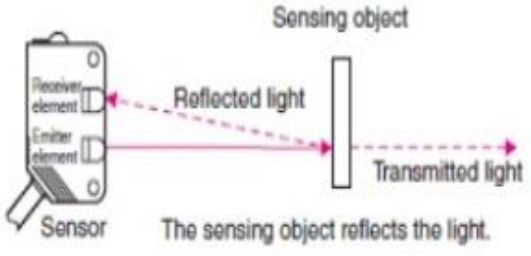

Fig-3: Diffused Sensors

3. LITERATURE SURVEY

Rakesh R et.al. Have proposed an innovative method of reading the shifting frequency of Retro reflective sensor [1] (a sort of photoelectric sensor) by doing research trials and also to statistical analyzes the collected observational data. They designed a technique which is used to catch this switching frequency of retro reflective sensor using PLC at the numerous levels especially low, medium and high. Examination of various frequencies at the various levels was made using Chi-square test, Correlation and descriptive statistics. These tools are statistically important quality measure of variation of the particular test to check the several level statistical software SPSS used.

Aye Aye Mar et.al. Have developed and tested an application for fluid combining within the unit system by the help of PLC [2]. Primarily, begin toggle is pressed. The fluids (juice and water) are combined within the stirrer by the help of valves. The quantity measure sensors will be aware of the finite liquid levels and mixer machine will begin to mixing. Liquidizer device is turned into working with the help of

timer. After the mixing activity get stops, the conveyor belt start going forward. When the bottle move towards photoelectric sensor, the conveyor belt will be halt then the machine fills the solution within the bottle by the timer. After the filling operation is completed, the pump machine stops and conveyor belt starts constantly. Whenever rest of the bottles goes by the sensing device, the conveyor belt waits and the filling process works repeatedly.

Kai Gao et.al. In this Photoelectric Sensors are utilized to notice the visual signal created by the working electrical instrument [3]. The infrared photoelectric sensor recognize the physical property such as temperature of electrical instrument, and the ultraviolet photoelectric sensor can expose the ultraviolet pulse signal created by imperfect release of electrical instrument. An insulation fault spotting method for electrical instrument supported by infrared and ultraviolet photoelectric sensing application is build. From the adjustable frizzy neural network, the insulation position and condition of electrical instrument is analytically decided by signs of photoelectric sensor.

Zhou Hao et.al. They make use of the design method of both hardware and software which brings in self-directed tracking by makes use of infrared reflective photoelectric sensors as the roadway identification sector [4]. The plan of action makes use of free scale HCS series 16 bit single-chip microcomputer as an important handler with the arrangement of photoelectric sensors for identifying the trail collection. It energizes the servo to drive and manipulate the speed of the DC motor consistent with the scanning of the path and speed data from sensing device. Therefore this smart vehicle can trace the black-line-guide perfectly and go ahead by tracking the line rapidly.

Asfa Javed et.al. Here the infrared sensors are constantly utilized sensors in obstacle and movement detector method [5], by make use of two sensors, Thru-beam and Diffuse Reflection, to examine their purpose and applicability with respect to various demands. The accuracy of thru-beam is depends on organization of transmitter and receiver. While on the opposite hand in diffuse-reflective sensors sensibility and dependability is mainly depends on calibration of device.

4. METHODLOGY

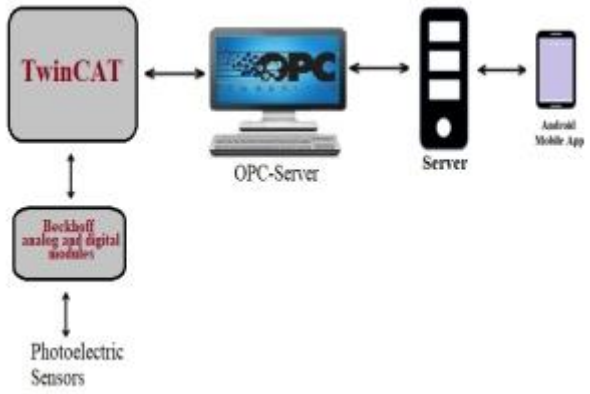

Fig-4: Architecture Diagram

Fig 4 shows the system architecture, the photoelectric sensor such as thru beam sensors, retro reflective sensors and diffused sensors are connected to Beckhoff 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 through TCP/IP protocols. With the help of developed Mobile application using API the data will be fetched and display the working of photoelectric 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.
- The chosen template automatically creates a program, which is called by a task. Required language can be automatically selected as the programming language.

- For adding objects open project, select an entry in the project tree, for example the folder POUs. 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.

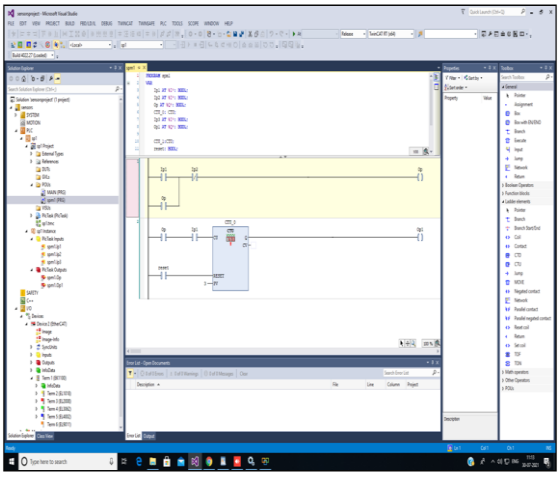

Fig-5: Ladder Logic Programming

Fig 5 shows Ladder Logic Programming in a Twin cat Software. After Successful configuration and creation of the project, a programming is done for specific sensors in order to manipulate its working. In this project Up Counter is used for counting up the number of times the object is interrupted between the sensor emitter and receiver.

4.2 Module 2

OPC Configuration:

With Twin CAT 2.8 or higher a Twin CAT OPC Server 4.1.0.79 the OPC configuration has become very simple and have to be done just one occasion.

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

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

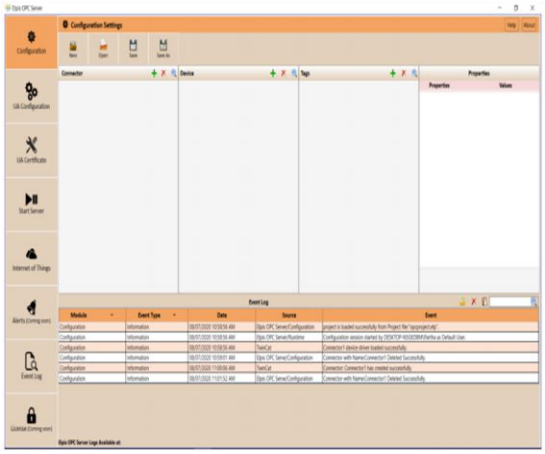

Fig-6: OPC Configuration

4.3 Module 3

Hydac Configuration:

- After successful login to the Hydac website.
- A new project is to be created by selecting the Twin Cat that currently using.
- Then need to select the type of ports that are required.
- Such as digital output configuration, analog input/output configuration port.
- Make sure the system configuration is setup properly.
- Once the lab and category is selected, the IPC configuration will be visible.
- Enter the project and variable name with "." in between.
- Enter valid address and click on submit
- User will be able to see an experiment data in the 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:

- Open Android Studio and create a new project.
- Add Dependencies.
- Design the UI for the Application.
- Create a model Class.
- Create an adapter Class.
- Create a retrofit instance.
- Define the endpoints.
- Send a GET request.

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 photoelectric sensors status as shown in the Fig 8. 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: Displays Experiment Data

6. CONCLUSION

The developed mobile application can receive the data from the server through API and can display the operation of sensors on the mobile screen. The OPC Server which has bidirectional communication with Twin Cat will fetch the data from the project that have to be free from errors and sent to the server which has taken input as Photoelectric Sensors to find the presence or absence of the object, this makes the Manufacturing industries work easier.

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