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## Reflective Optical Programmable Encoder Technology Review

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**ABSTRACT:** A new concept for a reflective lens less optical Technology photometer and receiver pair gives the all advantages over optical transmittive technology with of high signal integrity, relaxed gap between sensor and disc without affecting  $\sin/\cos$  and digital pulse, One more advantages is Resolution interpolations  $1X, 2X, 4X$  is easily achieved in small size even in 16mm outer diameter is possible. Motion parameters of speed, count, directions, displacements, velocity is easy to measure by using the reflective technology in integrations with mechanical shaft, Housing and bearings, these rotary structure is coupled to motor as a feedback device. Output of reflective photo sensor is connected to signal condition to a driver to achieve desired interface to connect the PLC, Drive, PC Counter, motion card

**KEYWORDS:** Reflective sensor, Motion parameter, PLC, Resolutions, Bearings

### I. INTRODUCTION

In human life Automation is the success key for development in every place in day to day. This need convert into save time, money, wealth of society and increasing better utilizations of resources and time. For that study the motion control is very important in respect of automations .motion may be linear, rotary, angular, curved, or any form .You say that it is a little bit point of contact always, in the live conditions and gives the feedback for control system without need of human input for corrections .to make control of mechanical motion interfacing to electronic card transducers are born. In early stage to control the rotary motions taco generator, potentiometer, Resolver, Magnetic Encoder, Optical encoder are used but now a day as the market becomes increasingly driven by consumer demands, businesses are forced into an intensified effort of meeting those demands to ensure business survival. It is a free for all in a business landscape that is filled with unpredictable sentiment and unforgiving circumstances. From suppliers to manufacturers, distributors to sales channels, all mechanisms involved in supporting the end products are faced with the seemingly unreasonable task of delivering products that are record-breaking miniature sizes; complete with extended capacities, high quality, while continuously maintaining a cost-down price structure. Validate for end use as desired/estimated in thought. An optical encoder has become recognized as an indispensable displacements /position sensor over magnetic sensor to its advantages of excellent immunity to electromagnetic interface, high resolution, light weight and less space .It plays a vital role in allot of industrial applications enabling precise positions control encompassing robotic controls printers, diamond cutting ,cut to length .the encoder which typically involves a code disc optical sensing head and signal circuits is classified into two categories of reflective or transmission depends on arrangements of light source ,code disc and photo detector. All transmission type encoder are usually pursued to conveniently dispose it's constitute

### II. LITERATURE REVIEW WORK

In applications of motion technology speed, position, velocity, accelerations are the key measuring parameters required to control some mechanical mechanism .Induction motor and servo motor control are required to control these motion,

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but controller cannot do its own it required feedback by means of various technology like magnetic, optical, inductive, capacitive, Each Technology have their own advantages and disadvantages to fit particular applications. various manufactures are producing the chip of reflective IC-Haus , Avego tech , Vishay semiconductor, honey-well each having their advantages and disadvantages . Recently all technology is driven by consumer market to fulfil the demand of less space, low cost better resolutions. Reflective technology with programmable o/p are the demand of motion markets .In recent Automation 2016 Expo in Mumbai tells the vision of customer need in coming year for India and global Control engineering ,Why need Transducer The Practice uses Sensor to measure o/p performance of the system being controlled And these measurements can be corrected for performance of actions When Device is designed to perform without the need of human input for correction then this Transducer are important. Tacho generator and resolver automation start with Induction Motor and Feedback device is tacho- generator The Major Principal for tacho generator is that relative motion between a magnetic field and a conductor result in voltage is generated .Magnitude are proportional to speed of motor Limitations are Commutator and Brushes are required frequently maintenance. Resolvers are electromechanical sensors that measure precise angular position; operate as variable coupling transformers, with the amount of magnetic coupling between the primary winding and two secondary windings varying according to the position of the rotating element (rotor), which is typically mounted on the motor shaft. Employed in industrial motor controls, servos, robotics, power-train units in hybrid- and full-electric vehicles and many other applications that require precise shaft rotation, resolvers can withstand severe conditions for a very long time, making them the perfect choice for military systems in harsh environments Standard resolvers have a primary winding on the rotor and two secondary windings on the stator. A potentiometer is a three terminal resistor with a sliding or rotating contact that forms an adjustable resistance .If only two terminals are used –one end and the wiper –it acts as a variable resistor or rheostat. The measurement of the potentiometer value is using a voltage divider, providing a linear responsiveness that makes them the simplest tool to make measurements. Potentiometers are available in different shapes and characteristics, allowing both linear and angular measurements. Inductive sensors the most commonly used inductive sensor is the Linear Variable Differential Transformer (LVDT). This is an inductive type position sensor, which operates based on the same principle as the AC transformer used to measure movement. This is a very accurate device for measuring linear displacement and its output voltage is proportional to the position of its moveable core... The sensor output indicate s the size of the gap between the sensor's sensing surface and the target capacitive displacement sensors for use in precision displacement measurement and metrology applications make use of electronic designs to execute complex mathematical functions . Capacitive sensors are not a good choice in dirty or wet environments A rotary encoder is a rotary transducer that converts an angular movement in a series of digital pulses. A common way to encode the position is to use a disk with slots, allowing the communication between the sensors in these slots. Therefore, when the disk is rotated, a signal is obtained depend ant on direction, position and speed. Depending on the electronics used, the rotary encoder could be optical, magnetic, mechanical and even conductive, but the latter is rarely used. Rotary encoders are usually integrated in the motors. Such a convenient solution can severely limit the performance of the whole robotic system in case of tendon transmission due to friction and elasticity effects Two variations of encoders exist depending on when the information is available the incremental and the absolute encoder . In the incremental encoder it is possible to measure position only when there Magnetic encoders are usually built using Hall sensors, which are based on the Hall Effect theory that is a voltage differential produced by an external magnetic field .That effect is due to the nature of the current flowing through a conductor device and placed within a magnetic field. The current is affected by the magnetic field; accumulate on the sides of the sensor. As the current is concentrating on the sides of the conductor, a voltage is produced between the two sides of the semiconductor material To generate a voltage across the device ,the magnetic field must be perpendicular (90degrees ) to the flow of current and have the correct polarity.

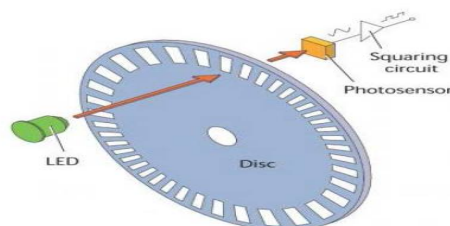


Fig 02: Incremental encoder [8]



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In year 2004 Takaomi Kojima, Yoshimi Kikuchi, Shigeo Seki, Hiroyuki, Study of high accuracy optical encoder with 30 bits in recent years, optical encoders have been widely applied in semiconductor product equipment, scientific measurement systems and nanometer technology systems. To use the encoder in these application fields, it is necessary to have the high resolution and accuracy encoders. There have been many studies on original fine disks with a high accuracy. However there are many problems regarding the high accuracy and resolution as follows. To make a high accuracy disk for an angular standard, it is necessary to make higher accuracy original disk rather than a drawing system of an original disk partner. There is no measuring system available which can provide measurements for both the length and angle disks. The high accuracy disk is very expensive and cannot be mass-produced so the angle sensor is expensive too. In 2014 Gabril Gabin and Aril Lutenberg „Jose Lipovetzky done COMS implementations of a programmable attenuation amplifier based a switched capacitors for an optical encoder [4] Optical encoders are sensors used to measure linear or rotational displacements in industrial and scientific equipment, such as radars, plotters, microscopes, etc. In previous papers our group presented the design of a customized photo detector array for a non-diffractive beam (NDB) optical encoder and the associated electronics. In those works the displacement was sensed by means of a generated photocurrent. In this work we propose a new scheme that uses voltages instead of currents based on a programmable gain switched capacitor amplifier. the first the optical circuit, consisting of the photo detectors array and it's associated circuitry. In year 2016 alternative Design for optical incremental encoder measurements systems by Abdul waheed, and Lilong cai dept of mechanical and aerospace engineering hong kong university of science and technology [5] An encoder system is commonly used as a passive device within a controller system. It is sampled by the controller with the same sampling time as that of the control system. Control loop requires time to execute set of commands hence sampling time of control system cannot be very small and is generally fixed. This limitation made utilization of M/T method unavoidable to measure high and low speeds by switching between M and T method at certain point.. Lack of available literature on accuracy of measurements by using M/T Method over wide range of speed, above mentioned limitations and problems associated with them motivated the authors to carry out this study. Digital filtering algorithms may be included with optical incremental encoders to form a smart measurement system. This will also relax computational requirements of control. Incremental encoder produces periodic signals when the encoder detects movement, In year 2014 Reflective Optical Encoder Capitalizing on an Index Grating Imbedded in a Compact Smart Frame Volume 6, Number 2, April 2014 Hak-Soon Lee Sang-Shin Lee Reflective Optical Encoder Capitalizing on an Index Grating Imbedded in a Compact Smart Frame Hak-Soon Lee and Sang-Shin Lee Department of Electronic Engineering, Kwangwoon University, Seoul 139-701, Korea Translations and content mining are permitted for academic research only. Personal use is also permitted, but republication/redistribution encoder has been proposed and realized capitalizing on a miniaturized sensing head, which integrates both a pair of index gratings and a beam route in a plastic smart frame. [1]. Avago AEDR-872x encoder is a three-channel optical encoder with two channels differential analog and a third digital index output. The encoder is designed to operate over -20 °C to 85 °C temperature range and so is suitable for both commercial and industrial end applications. The encoder houses an LED light source and photo-detecting circuitry in a single package. The small size of 3.95 mm (L) ×3.4 mm (W) ×0.9562 mm (H) allows it to be used even in a wide range of miniature commercial applications in which size and space is a primary concern. The AEDR-872x encoder, with two channels differential analog outputs (Sin, /Sin, Cos, /Cos) can be interfaced directly with most of the external interpolators available. As such, the encoder provides great design-in flexibility and easy integration into existing sys Analog Output option: Two-channel differential analog output and with a digital index output Surface mount leadless package: 3.95 mm (L) ×3.4 mm (W) ×0.9562 mm (H) [7] Built-in LED current regulation, and so no external biasing resistor is needed -20 C to 85 °C absolute operating temperature High encoding resolution: 318 (lines/inch, LPI) .[7] Vishy Optoelectronic Sensors The change in the light signal caused by the interaction with the object then produces a change in the electrical signal in the optoelectronic receiver. The main difference between reflex couplers and transmissive sensors is in the relative position of the transmitter and detector with respect to each other. In the case of the transmissive sensor, the receiver is opposite the transmitter in the same optical axis, giving a direct light coupling between the two. In the case of the reflex sensor, the detector is positioned next to the transmitter, avoiding a direct light coupling. The transmissive sensor is used in most applications for small distances and narrow objects. The reflex sensor, however, is used for a wide range of distances as well as for materials and objects of different shapes.[7] The main difference between the sensor types is the mechanical resulting in various electrical parameters and optical to each other. Electrical interference signals can be generated in the detector when the transmitter is operated with a pulsed or modulated signal. The transfer capability of the interference increases strongly with the frequency. [7]

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## III. PROBLEM STATEMENTS

In various motion applications previously induction motor are the prime drive, But efficiency around 85% to control the motion Drive need feedback from some means ,originally taco generator from which Voltage o/p are converted in to frequency that frequency is feed to drive to control the motion of motor In recent developments of Servo motor having the high starting Acceleration and de accelerations Efficiency and speed are increased to get that high frequency Magnetic and optical transmittive, capacitive and inductive technology are developed. But each technology have some disadvantages from various applications point of view and consumer expectations, to achieve the result manufacturing of such product is the dream of motion people . Manufacturing is tough challenges in precise manufacturing of product .It involve the Mechanical Precision and electronics Asics Technology. To use such technology in automation applications to achieve the good results. Challenges like to generate the jitter free o/p signal, to make higher resolutions by using programming techniques to measure and control the applications like CNC machine ,solar tracking Robots Harsh environmental conditions, Welding applications and Turn table where EMI/EMC , Surge voltages , Linear voltage Regulator Design , Optical alignments plays vital role . In recent reflective technology some challenges are resolved to simplify the product and size iC-Haus News Release Encoder blue Page 2 /3Blue LEDES are the basis for white emitters which are in extreme demand by the automotive and illumination markets. Today, long term temperature - stable blue LEDs are available which outshine the IR and red LEDs used in encoders so far, because they offer higher light yield and efficiency at even lower cost. optical position sensors benefit notably as a result of the technological progress of both led and CMOS technology. iC-Haus has optimized the new incremental scanners in its high resolution iC-PTH-Series especially for blue light. The integration platform for such single chip encoder s is denoted by the trademark Encoder blue .The new encoder chips of the iC-PT H-Series combine optimized scanning and signal interpolation in the smallest available space: a flat 5 x mm<sup>2</sup> opto QFN package with a plane window. Due to the optimized Phased – Array structure of the opto-chips, a minimal scanning area of only1.9 mm x 3.1 mm is sufficient to generate 10,000 pulses per revolution using a code disc of only 26 mm diameter, for example . The blue light increases the contrast with lower noise and the improved efficiency reduces the current consumption within the optical system [7]

## IV. METHODOLOGY

In a reflective encoder, light from a light source bounces back from a moving code wheel and is sensed by the photo-detector, which is located on the same side of the code wheel as the emitter. When light from the light source is projected onto the moving code wheel or code strip, the bars act to reflect or not reflect the light, at intervals. This repeated action creates moving shadows that fall on the photodiodes located on the detector.

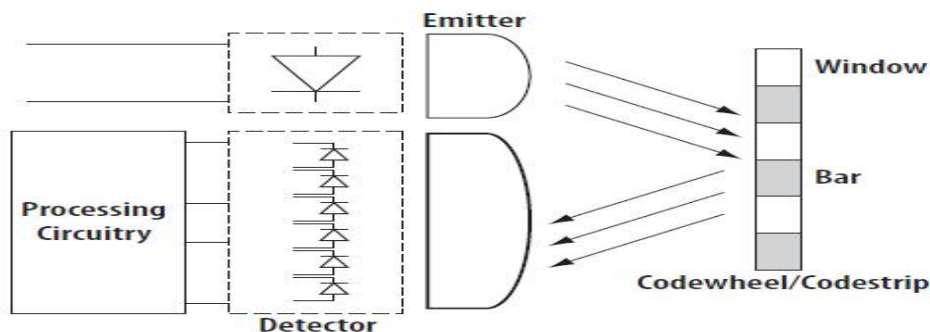


Fig03. Reflective optical basic encoder [7]

## V. BLOCK DIAGRAM

From the block diagram it is understood that input is d c supply and give the Transmitter and receiver output from Receiver is is given to Electronic circuit and after that to interpolator for getting multiplied output and in can configured as required for controlling the accuracy

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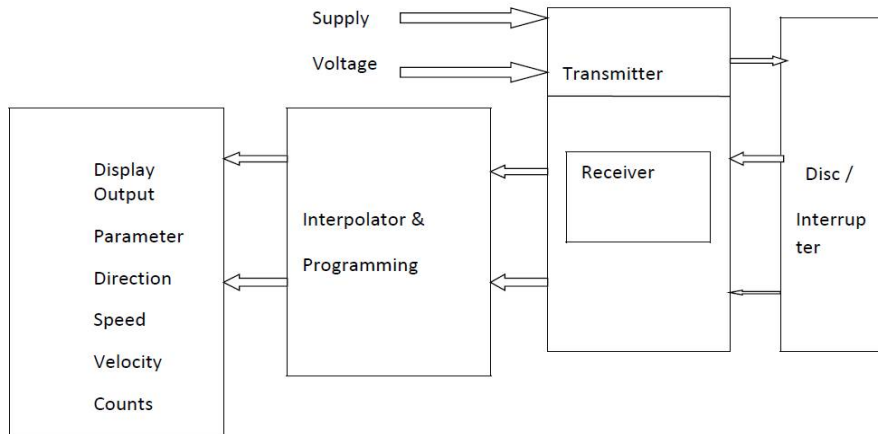


Fig04. Block diagram of reflective optical programmable encoder

## VI. REFLECTIVE TECHNOLOGY RESULTS

Reflective technology output waveform at various type like square wave and sin/cos wave are shown below to use in various applications like, Printer, Robot positions, Cnc machine spindle speed control-y position control

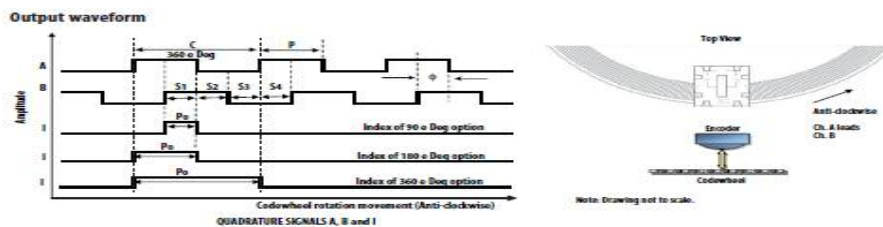


Fig 05: Avago-tech -AEDR-850x output waveform presentations [7]

From Fig 05 Output of Reflective encoder Square wave called is A, B, Z output, Output of A, B are 360 degree in one rotations and A signal is leading to B signal in Clockwise direction and vice versa in anti clock wise directions Z signals are getting in one time in 360 degree of rotations of shaft Pulse width can be configured

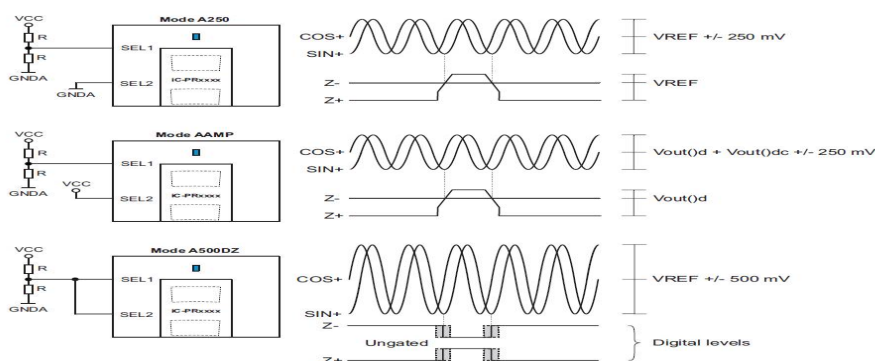


Fig06: IC-HAUS PR Sensor output wave form presentations [7]



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Fig 06 Output of Reflective encoder using the IC-HAUS PR sensor SIN and COS signal as a output is possible in this case SIN signal is lagging to COS signal in Clockwise directions and vice versa .Z signal we can configure for the pulse with as we required By selecting the resistance combinations

## VII. CONCLUSION AND FUTURE WORK

The new principle of Reflective optical encoder has been use to built the proto type unit. A theory can be suggest As we required to built functional prototype designed with programmed o/p for measurements of different parameters ike direction, speed , velocity, displacements , counting, angle . Due to the large eccentricity of the encoder's mechanical part, the accuracy is worse than the resolution. By using the reflective technology size and calibrations of the coder is easy, much better accuracy can be achieved. The influences of mechanical tolerances in axial direction to the optical system have been no more critical Furthermore the new encoder concept needs only few optical components and can be adapted and optimized for various applications In future pulses per rotations can be changed by programming of encoder on IOT base on field is possible and communication to various interfaces is possible by using various

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