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Design of Robotics Technology for Application in the Electrical field with narrow and hazardous space

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***Abstract*—** Robotics is the branch of technology that deals with the design, construction, operation and application of robots [1] and computer systems for their control, sensory feedback, and information processing. These technologies deal with automated machines that can take the place of humans, in hazardous or manufacturing processes, or simply just resemble humans. Many of today's robots are inspired by nature contributing to the field of robotics. The concept in creation of machines that could operate autonomously dates back to classical times, but research into the functionality and potential uses of robots did not grow substantially until the 20th century.[2] Throughout history, robotics has been often seen to mimic human behavior, and often manage tasks in a similar fashion. Today, robotics is a rapidly growing field, as technological advances continue; research, design, and building new robots serve various practical purposes, whether domestically, commercially, or militarily. Many robots do jobs that are hazardous to people such as defusing bombs, exploring shipwrecks, and mines. In this way electrical field has wide area where we can use the robot instead of our conventional methods. In power system generation boiler is one of the place where the robot technology is widely used for maintenance purpose because human maintenance is too difficult due to high temperature but robot can easily perform the maintenance in live condition also In a narrow space or a hazardous space human effort is not applicable properly in that case robot can do important task to perform proper maintenance. For an example, we can observe the facts like 1. Crack detection test in boiler inner wall, 2. Any type of physical operation at nuclear reactor. 3. Clearing any obstacle in a hollow channel. 4. Commissioning any instrument in a narrow space 5. Spot welding etc. This type of operation by human is very troublesome, injurious and harmful. Sometimes it may causes death. The implementation of robotics in a complicated, hazardous or narrow space is an efficient and economic approach. In this paper the basic operation of robot in narrow and hazardous space is stated.

***Index Terms*—** robotics, robotics applications component; plc, scada different type of scanning system, level sensor, dc motor, dc motor driver, analog and digital communication. Simulation packages

I INTRODUCTION

Robotic application in hazardous / narrow field is very efficient, and economic.[fig1] Through this type of application,

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We may perform scanning, video photograph, and some physical action. In a narrow, or congested space where human eye could not suited, there video-photography by

Robot is very much effective. In same situation, where human hand could not reach, scanning like radio-graph test, ultrasound tests. Magnetic particle test etc done by robot is economic and reliable. The most important task in a narrow and hazardous space, are rearrangement of cables from its contingency, clearing of obstacle from a channel, or commissioning an instrument in a underground channel. Through this paper application in narrow, hazardous,. Underground space is stated. Controlling and data-acquisition through PLC, SCADA is much effective and economic. An analysis of some application is discussed. Say in boiler inner wall, there should be a periodic crack test and crack test in gas pipe line are very difficult, risky, cost effective. If there found any hair crack, then a necessary action will take place otherwise it will cause a devastating accident. In some case cable contingency underground or under sea etc have to be overcome. In those cases robotic application is very effective approach. In this paper a line-following robot movement and arm movement are stated. The scanning or video-photograph can be performed. By this system a data acquisition also is performed. To perform spot welding in hazardous space robot is helpful. [fig 1,11]

II LITERATURE REVIEW

To design of Robot first Plc and SCADA knowledge are based on Rockwell and Scimence and robotic application adopted from some famous gadgets published in India and also taken some practical experience in industry. Many papers were searched from Google cutting edge robotics 2010 by Vedran Kodic, a new approaches in automation and robotics by Haruld Aschemann, robot localization and map building by Hanafiah Yussof, robot Manupulators, trends and development by Dr. Austin Jimenz, Dr. Basil m. al. Hdithi.These literature has been properly analysied to design of this paper.In this paper we have design a better robot to work in Electrical field.In this paper we have highlighted how to design a robot to applications in different narrow and hazardous space maintained in electrical components. This design is much better compare then stated conventional robot which is analysis in those and previous research papers

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III PROBLEM ANALYSYS

In case of boiler inner wall crack detection. There is a difficult task to scan per square inch .But in this case, a robot which controlled by PLC and SCADA can scan the wall very clearly and efficiently. The scan photograph could be stored in memory .Later a human eye can detect any crack and its location of the wall by watching the photo-graph in control room.
In case of sewage /water/fluid pipe line, some time there some obstacle may trapped .Then the flow become stopped. This type of situation could be handled with a robotic arms application. A robot can take a photograph of the obstacle and send it to video by CCTV set up. By observing this an operator operate the arms by SCADA and PLC to clear the obstacle.
In case of cable/optical fiber channel, some time it was broken/contingent. In this situation a robotic arms set up with SCADA control can be effective steps to overcome the situation.

IV DIAGRAM OF ROBOT

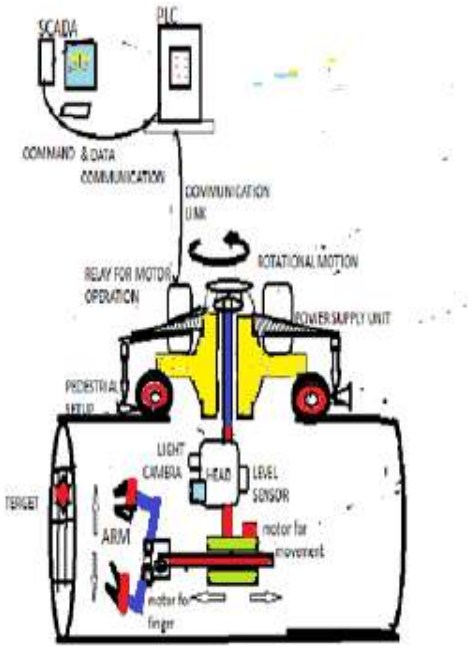

FIGURE 1: ROBOTIC APPLICATION IN A NARROW SPACE/ CHANNEL

This diagram is design in PLC and SCADA how it is used for robotics applications and it can work through a narrow space where human effort could not reach.

V OPERATION DESCRIPTION

In this type operation, there comprise of some module, control unit, communication module, sensor module, scanning module, CCTV camera, dc power supply module, relay, motor driver.

A CONTROL UNIT

In a control unit, there should be a PLC with an analog I/o module, SCADA monitor, or there may be a DCS. A plc consists of power supply unit, CPU module, Inter face module, digital I/O module, analog I/O module. In case of shoo box PLC all module are in compact form, A separate p.s. unit with 220v ac,/ 24vdcetc are available with it. CPU unit is serves as a brain. It performs the task according to command and sends the data to SCADA monitor, after processing the information collected by sensor, scanner. In SCADA system all the present status are shown. By observing this an operator can take decision.

B PLC

Before the advent of solid-state logic circuits, logical control systems were designed and built exclusively around electromechanical relays. Relays are far from obsolete in modern design, but have been replaced in many of their former roles as logic-level control devices, relegated most often to those applications demanding high current and/or high voltage switching. The purpose of a PLC was to directly replace electromechanical relays as logic elements, substituting instead a solid-state digital computer with a stored program, able to emulate the interconnection of many relays to perform certain logical tasks.

VI LADDER DIAGRAM

Ladder diagrams are specialized schematics commonly used to document industrial control logic systems. They are called "ladder" diagrams because they resemble a ladder, with two vertical rails (supply power) and as many "rungs" (horizontal lines) as there are control circuits to represent. [fig 2] If we wanted to draw a simple ladder diagram showing a lamp that is controlled by a hand switch, it would look like this:

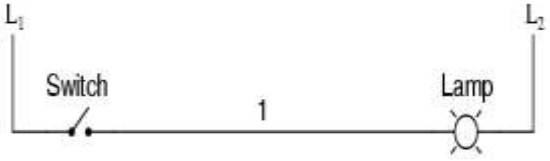

FIGURE 2: LADDER LOGIC RUNG EXPLAINATION 1 [5]

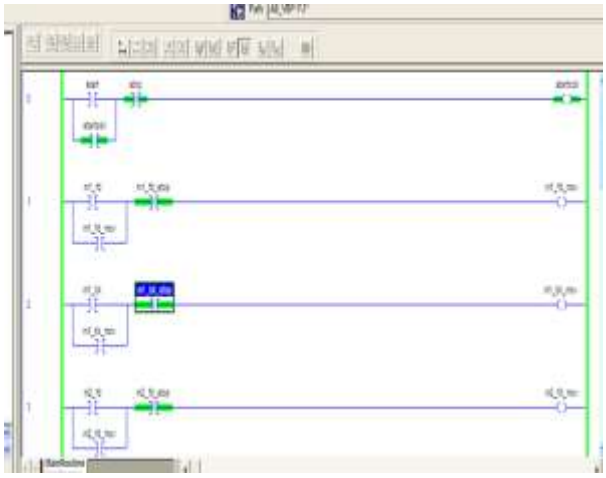

FIGURE 3; LADDER LOGIC PROGRAMMING FOR ROBOT OPERTION, PART 1[7]

The "L_1" and "L_2" designations refer to the two poles of a 120 VAC supply, unless otherwise noted. L_1 is the "hot" conductor, and L_2 is the grounded ("neutral") conductor. These designations have nothing to do with inductors, [fig5] just to make things confusing. The actual transformer or generator supplying power to this circuit is omitted for simplicity

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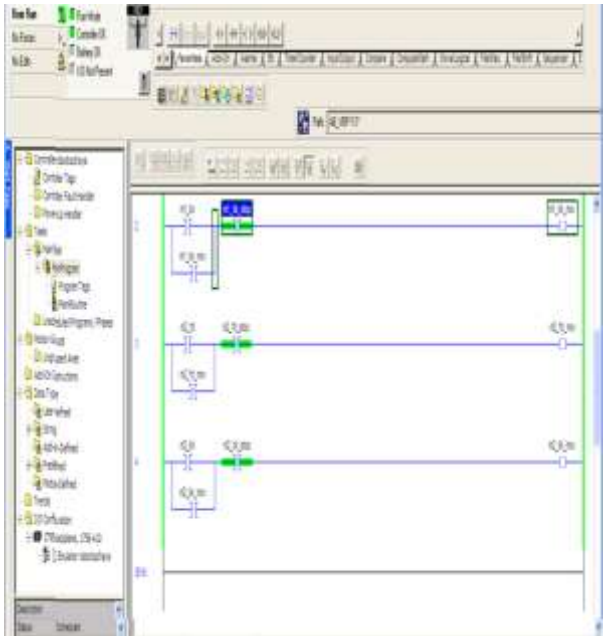

FIGURE 4: LADDER LOGIC PROGRAMMING FOR ROBOTIC OPERATION, PART 2 [7,8]

In reality, the circuit looks something like this:

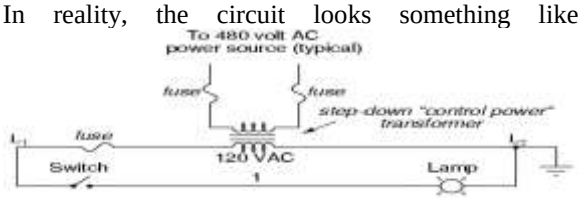

FIGURE 5: LADDER LOGIC RUNG EXPLAINATION 2[5]

VII COMMUNICATION MODULE

A CCTV arrangement manages to take a video-photo graph of the target, and send it to operator's video screen. In this case 425/625 line communication, CCD(charged couple device),analog communication are adopted. The communication between SCADA and PLC is done by Ethernet communication/mod bus communication/multi port interface etc. and by the specified software arrangement. The communication between PLC and relay module is done by either wireless communication/ simple bus communication. The communication between sensor module and PLC is done by analog communication.

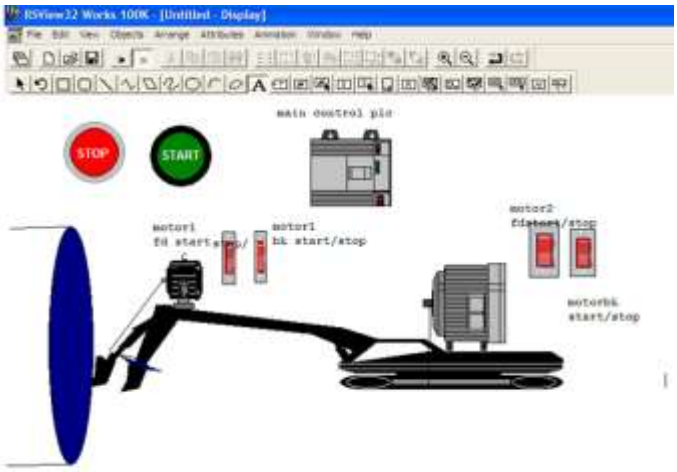

FIGURE 6 ; SCADA FOR ROBOTIC OPERATION [7,9]

A BLOCK DIAGRAM

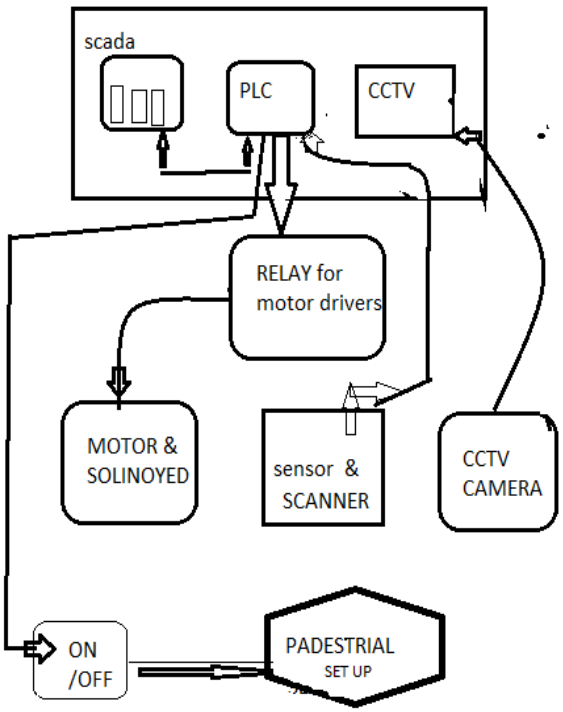

FIGURE 7 : ROBOTIC CONTROL SCHEME

VIII ROBOT PROGRAMMING

The main importance of robot functionality is its movements and control. The functionality of a robot is depends on the programming. The programming can be done in ladder logic for PLC[fig3,4] and SCADA.[fig 6] In the ladder logic programming a logical ladder should be built by NO/NC switches, input from sensors, output by relay coil, timer, counter etc. Then run this program by simulator. After this arrange a SCADA page/pages for final controlling by mouse/kea switch/ touch screen and observe the process directly by animated figure. There should be a manual option.

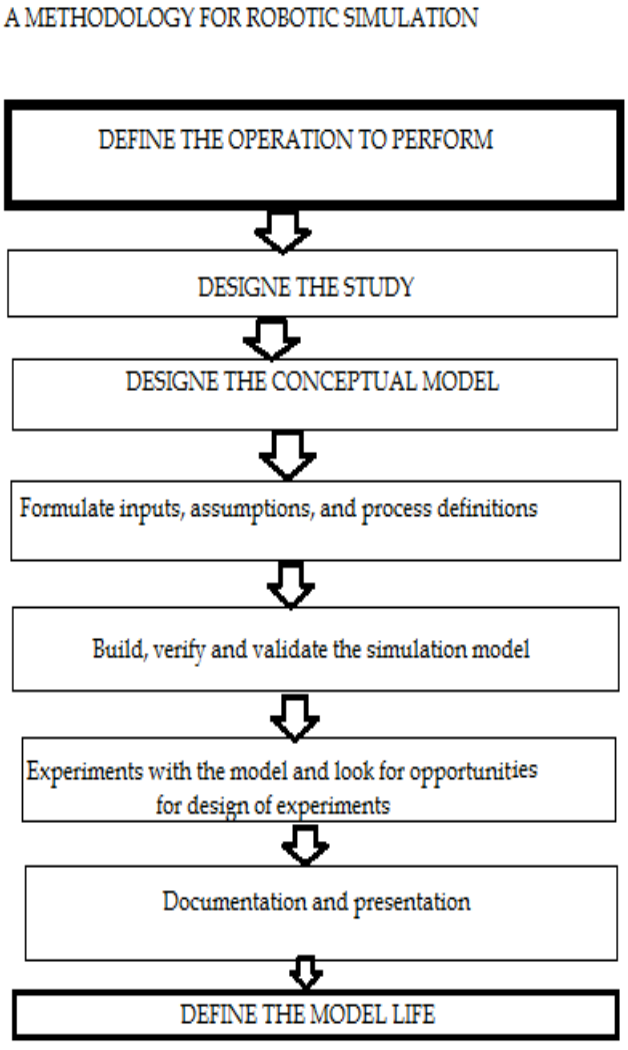

FIGURE 8 : OPERATION FLOW CHART

IX OTHER SIMULATION PACKEGE:

The robotic simulation package is a tool which is used to create embedded applications for specific robot. MATHLAB-SIMULINK can be use significantly in robot simulation. Virtual Relay Modeling language is a simulation package in which simulation of robot can be done. Java-3D Is a simulation package which provide an object-oriented –language-base approach for designing a 3D system. Java 3D offers a high-level Application Programming Interface (API) for 3D scene description and graphical control. Besides that, it also allows for a fully object-oriented approach to define and control the virtual agent and its environment. Java3D is also designed to take advantage of multi-threaded programming techniques, allowing for better performance from the implementation. Of robot is one of most popular mobile robot simulations and is widely used for educational purpose. It uses the ODE (Open Dynamics Engine) for collision detection and simulating rigid body dynamics. It contains a rapid prototyping tool, allowing the user to create a 3D virtual world. It runs on Windows, Linux and Mac OS X.

X ROBOT PEDESTAL SET UP

In robot pedestal set up, in robot pedestal set up, it is moveable.[fig 7] In this design, movement of pedestal is not included by the controller. Two light detecting sensors are mounted at the front of two wheel set up. The path is provided by white color. The TCRT5000L REFLECTIVE SENSOR includes an infrared emitter and photo transistor in leaded package. So that the robot can set itself as per its line, to make its head/ arms at a stedy or straight motion .When an object comes in the sensing area, the emitted IR light reflects off the object back to the photo-transistor. So the amount of light energy reaching the detector increases. This change in light energy or photo-current is used as the input signal to activate the motors of the line- follower robot. The motor driverL293D is interfaced with sensors and controls the 12v geared dc motor. The L293D is a quadruple high-current, half –H- driver. It is designed to provide bidirectional drive current of up to 600ma at 4.5v to 36 v. The device is designed to drive inductive loads such as motors as well as other high-current/high –voltage loads in positive-supply application. The power switch must be controlled by PLC, when a comfortable space is selected the movement of pedestal should be stopped. A break for wheel and some stopping legs should be arrange so that it become steady when it required.

A ROBOT ARMS

The robot arms operation is compounded of different type motor operation and solenoid operation as per requirement .The arms can move in forward and reveres direction by dc motor and dc motor drive.(in this type of operation dc stepper motor is effective). The tongs/ finger operation can be done by solenoid- plunger/ hydraulic jack.[fig10] The tongs/finger and arms movement can be controlled by SCADA and PLC

B ROBOT HEAD

It consist of ,as per requirement a high intensive light, ultra sound instrument / magnetic particle test instrument for crack detection/ radiography test instrument etc for crack detection. A camera for CCTV photography [10]
Here is sensor module for level /depth measurement. Ultrasound sensor /infrared level sensor may serve purpose. A sensor arrangement for scanner movement in a array format.

C DIAGRAM SCANNING OPERATION

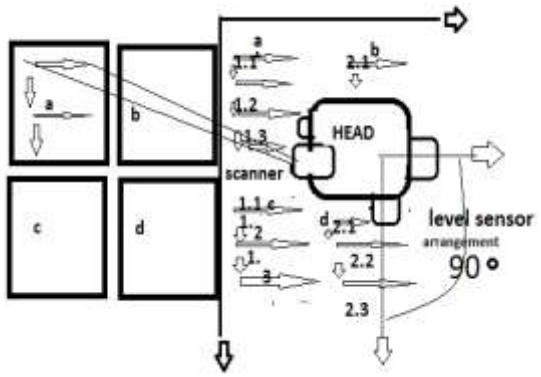

FIGURE 9 : SCANNING SCHEAME

XI IMPLEMENTATION

In cases of underground optical fiber channel, electrical line cable, communication line, sometimes, various type of faults may appeared, like contingency of cable, punching of cable,, brake of cable. The channel may be narrow, may passed through hazardous area, like under the sea ,radio active area.. In this type of cases human effort is less relevant. So in this type of application this project may very fruit full.
In case of crack detection of gas line pipe, in underground, this type of project is effective.
In case of small capacity boiler, like 5 tons fire tube boiler, the combustion chamber is very narrow. The dia meter of the combustion chamber is about to 45cm. and length is about 360cm. to maintain safety, the boiler inner wall, i.e. combustion chamber wall, should be examine in periodic crack detection test. To perform crack detection test manually , like magnetic partial test, ultra violate crack detection test, human element have to be entered in to the closed narrow space. Therefore, many times human element may die due to accident, like closure fobia, lack of oxygen supply,etc.
Besides it, this type of vital work is not performed accurately due to lack of human effort. So the scanning may not performed with better accuracy. In this type of works, this application is very effective.

FIGURE 10 ;HARDWARE CONGFIGURATION OF A ROBOT FOR NARROW & HAZERDUS SPACE OPERATION

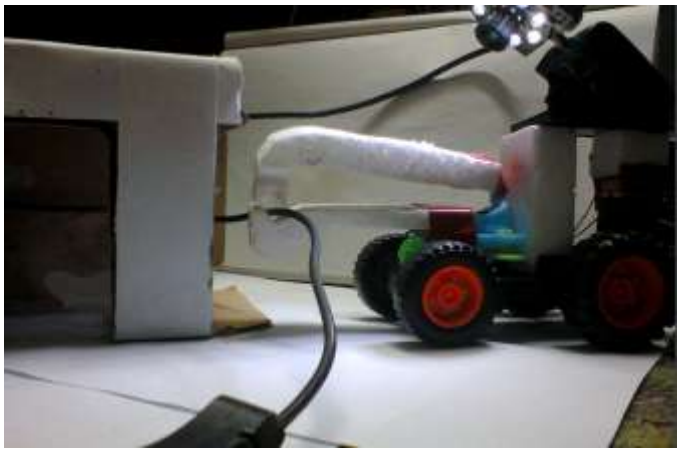

FIGURE 11 : ROBOT IN ACTION WITH HOLDING A CABLE , CLEARING IT FROM A NARROW CHANEL

X II CONCLUTON

Arrangement is done by mechanical and electrical arrangement. The PLC, SCADA operation is much reliable, economic and time span reducing, and safety through this paper, an approach to many difficult tasks will be overcome. The robotic effort. The action like scan, control, and alarm and data acquisition could be performed. Through this paper a fundamental and practical knowledge about narrow, hazardous, complicated space is stated. Successful application of this type of project will serves in many difficult tasks, which could not be overcome by human effort.

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