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DESIGN AND FABRICATION OF SMART MODIFIED RAILWAY CROSSING

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Abstract: The Pneumatic system plays a crucial role in the industrial world today. It involves an arrangement of different components that regulate, direct, sense, and command it to achieve the desired outcome. The working media in Pneumatic systems is fluid power, which refers to the utilization of fluid media under controlled conditions to perform useful work. The use of fluid power in industries has been vital in the development of automatic machinery and equipment for industrial plants. The fluid media used for power transmission has many advantages over other forms of power transmission media. With this in mind, a pneumatically operated railway gate crossing has been designed to avoid accidents at level crossings. This is in contrast to manually operated railway crossings, which often lead to accidents and delays. By utilizing pneumatic technology, reliable operation can be achieved in unmanned level crossings, thereby preventing errors that could arise from manual operation. In several applications such as process industries, robotics, and other areas where automation is required, pneumatic technology has become increasingly popular. Its cost-effectiveness and efficiency have made it an essential component of automation technology and it can be used to simplify complicated mechanisms, as seen in various railway crossings

INTRODUCTION

Rail transportation is a widely preferred mode of travel, but it has its own set of challenges, such as accidents at unmanned railway crossings caused by manual operation or the lack of staff. This project proposes a solution to automate the control of these crossings using electronic components. By installing sensors at a certain distance from the gate, the system detects approaching trains and adjusts the gate's operation accordingly. Additionally, an indicator light alerts motorists about the approaching train, thereby reducing the risk of accidents. The manual traffic monitoring and control system is a major cause of road accidents in India, and railway signaling systems are no exception. Level crossings, where tracks intersect with highways or roads, pose a significant risk of railway-road accidents, and the absence of railway crossing systems only exacerbates the issue. To address these challenges, an automated monitoring and control system for railway crossing signals is proposed. This system can remotely monitor the running status of railway crossing signal equipment in real-time, record dynamic data, and perform remote analysis. The demand for such automated monitoring and control systems is high, given their potential application in various areas of life..

NEED OF THE STUDY.

This project aims to implement mechatronics technology to automate unmanned railway gates. Historically, early level crossings used a flagman to manually stop traffic and clear the tracks, and later, closable gates were introduced. These gates were initially designed to act as a complete barrier against intrusion from road traffic onto the railway, especially considering that much of the traffic in earlier times was horse drawn or included livestock. However, with the advent of motor vehicles, the effectiveness of these gates as a barrier decreased, and in many countries, weaker but more visible barriers were introduced with warning signals to stop road users. Nevertheless, uncontrolled level crossings with only warning lights or bells continue to present a significant safety risk, particularly in countries like India, China, Thailand, and Malaysia, where they are often manually operated. To address this issue, this project proposes using a sensor with a load cell placed beside the railway track to detect approaching trains and send an electrical signal to a solenoid valve, which then activates a cylinder to operate the crossing gate and prevent any pedestrians or animals from getting onto the track

Problem Identification

Present project is designed using microcontroller to avoid railway accidents happening at unattended railway gates, if implemented in spirit . this project utilized two powerful ir transmitter and two receivers ,one pair of transmitter and receiver is fixed at up side (from the train comes)At a level higher than a human being in exact alignment and similarly the other pair is fixed at down side of the train direction. Sensor activation time is so adjusted by calculating the time taken at certain speed to across at least one compartment of standard minimum size of the Indian railway we have considered 8 second for this project. Sensors are fixed at 1 km on both side of the gate. We call the sensor along the train direction as fore side sensor and the other as aft side sensor .when fore side receiver gets activated , the gate motor is turned on in one direction and the gate is closed and stay closed until the train crossing the gate and reaches aft side sensors.

When after side receiver gets activated motor turns in opposite direction gate opens and motor tops. buzzer will immediately sound at the fore side receiver activation and the gate will closed after 5 second , so giving time to the driver to clear gate area in order to avoid trapping between the gates stop sound after the train has crossed.

4. Concept of Model

Presently manually operated railway crossings cause many problems like accidents and time delay, Pneumatic operated automatic railway gate control type of gates can be employed in an unmanned level crossing where the chances of accidents are higher and reliable operation is required. Since, the operation is automatic error due to manual operation is prevented. At present scenario, in the level crossing line the railway gate is operated normally by a gate keeper. This happen when the railway line is cross over the road and there are a gate that have to be controlled The gate keeper work after receiving the information about the train arrival from the nearer station. When the train starts to leave the station, the particular station delivers the information to give the signal for gate keeper to get ready. This is the operation are followed for operating the railway gates. In addition, this automatic railway gate system can contribute a lot of benefit either to the road user or to the railway management. This type of gate can be implementing in the level crossing where the chances of accidents are higher. The computer integration will be use to provide addition in the latest technology.

5. Methodology

1. Design the shape and size of model of project.
2. Selection of material and components utilized in fabrication of innovative project .
3. Finding the requirement of equipment's for measuring the different parameters.
4. Fabrication of different components for experimental set up according to design.

Performance on the experimental set up

6. Components Details

Following are the main components used in project—

1 Pneumatic Actuator
2 Pneumatic Direction Control Valve 5/3
3 Flow Control Valve
4 Pu Tube
5 Slider
6 Ir Sensor
7 Relay
Dc Dry Battery

An actuator is a device that converts input energy into mechanical motion or other types of useful work. It receives control signals from the system, and the output signal is used to control the final control element. In addition, there are other types of output devices that are used to indicate the status of the control system or actuator. It is important to ensure that these output devices are functioning properly to ensure the effective operation of the overall system.

A pneumatic direction control valve 5/3 is a type of valve that is commonly used in pneumatic systems to control the direction of air flow. It has five ports and three positions, hence the name "5/3". These valves are used to control the direction of air flow in pneumatic cylinders, motors, and other pneumatic devices.

The valve works by using compressed air to control the movement of a spool or other internal mechanism that directs air flow. When the valve is actuated, the internal mechanism moves to one of three positions, allowing air to flow to one of two output ports or blocking air flow altogether.

Pneumatic direction control valves 5/3 are available in a variety of sizes, materials, and configurations to suit different applications. They are commonly used in industrial automation, manufacturing, and other industries where precise control of pneumatic systems is required.
A pneumatic flow control valve is a type of valve that regulates the flow of compressed air in a pneumatic system. It is used to control the speed of pneumatic cylinders, actuators, and motors by restricting or allowing the flow of compressed air.
In the context of railway crossing gate opening, a pneumatic flow control valve can be used to control the speed at which the gate opens and closes. The valve is installed in the pneumatic circuit that controls the gate, and its flow rate is adjusted to ensure that the gate opens and closes at a safe and controlled speed.
By controlling the speed of the gate, the pneumatic flow control valve helps to prevent accidents and improve the overall safety of railway crossings. It is an important component of the pneumatic system used in railway crossings, and plays a critical role in ensuring the safe and efficient operation of these systems.
PU tube, or polyurethane tube, is a type of flexible tubing that is commonly used in pneumatic systems, including those used in railway crossing gate mechanisms. The tube is lightweight, durable, and resistant to abrasion, making it ideal for use in harsh environments.
In railway crossing gate mechanisms, PU tube is used to transport compressed air from the control valve to the pneumatic cylinder that operates the gate. The tube is connected to the valve and the cylinder using fittings, which ensure a secure and leak-free connection.
The use of PU tube in railway crossing gate mechanisms helps to ensure the reliable and efficient operation of these systems. It is an important component of the pneumatic system, and must be selected and installed correctly to ensure that it meets the specific requirements of the application.
Infrared (IR) sensors are commonly used in railway crossing systems to detect the presence of trains and other large vehicles. These sensors operate by emitting a beam of IR light and detecting the reflection of that light off of a nearby object. When a train or vehicle passes through the beam, the sensor detects the change in reflection and sends a signal to the control system.

In railway crossing systems, IR sensors are used to trigger the closing of the gate and the activation of the warning lights and sounds. They provide an additional layer of safety by ensuring that the gate is only closed when a train or vehicle is actually present.
IR sensors are preferred for use in railway crossing systems because they are highly reliable and can operate in a variety of weather conditions. They are also relatively simple to install and maintain, making them a cost-effective solution for railway crossing systems.
In addition to their use in railway crossing systems, IR sensors are also used in a variety of other applications, such as security systems, automatic doors, and traffic monitoring systems. They are an important component of modern technology, and are used to improve the safety, efficiency, and reliability of a wide range of systems and devices.

Relay sensors are used in railway crossing systems to detect the presence of trains and activate the crossing gate mechanism. These sensors are designed to detect the electromagnetic field created by the train's presence, and trigger a signal to the control

system, which in turn activates the crossing gates.

The relay sensor consists of a coil and a switch that are connected in series with a power source. When a train passes by, the electromagnetic field created by the train's movement induces a current in the coil, which activates the switch and sends a signal to the control system.

Relay sensors are highly reliable and accurate, and are designed to withstand harsh environmental conditions such as extreme temperatures, moisture, and vibration. They are often used in conjunction with other sensors, such as pressure sensors and infrared sensors, to ensure that the crossing gates are activated in a timely and safe manner.

In railway crossing systems, the use of relay sensors helps to improve the safety of the crossing by ensuring that the gates are activated in response to the presence of a train. This helps to prevent accidents and ensure the safe and efficient operation of the railway crossing. Reliability and accuracy are crucial in railway crossing systems, and the use of reliable and accurate sensors such as relay sensors is essential in achieving this.

A DC battery is a type of battery that uses direct current to provide electrical power to devices. In railway crossing sensors, DC batteries are commonly used to power the sensors and their associated electronics.

Railway crossing sensors are devices that detect the presence of trains on the track and trigger the crossing gate to close. These sensors are typically installed near the track and use a variety of detection methods, such as infrared sensors, pressure sensors, and magnetic sensors.

DC batteries are used in railway crossing sensors for several reasons. Firstly, they provide a reliable and consistent source of power to the sensor, even in the event of a power outage or other disruption to the main power supply. This is critical for ensuring the safe and reliable operation of the crossing gate.

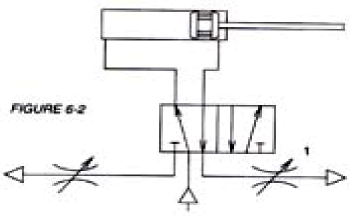
Additionally, DC batteries are often used in railway crossing sensors because they are compact and easy to install. They can be mounted in a variety of locations, and their small size and light weight make them easy to handle and transport.

Finally, DC batteries are often used in railway crossing sensors because they are cost-effective and have a long service life. They require minimal maintenance and can last for several years, making them an ideal choice for railway crossing applications.

Overall, the use of DC batteries in railway crossing sensors is essential for ensuring the safe and reliable operation of these critical safety devices.

The above 2D design shows the simplest construction for the underground brigades, which are fixed below ground level. An actuator (cylinder) is mounted on the brigades, and it responds to the control signals sent by the pneumatic valves. The I/R sensor is cut, and it signals the 5/2 solenoid valve to actuate and divert compressed air from the inlet port to the front side surface of the piston. The compressor takes free air from the atmosphere as the air source, and the outlet of the compressor air line pipe is connected to the inlet of the pneumatic valve, which has two positions and five ports. One position is used for pull, and the other is used for push operation of the brigades. The two outlets of the valves are connected to the two ports of the actuator.

FIGURE 6-2



During the upside movement of the brigades, compressed air is supplied to the pneumatic valve at the inlet position. At first, the compressed air is diverted to the back side of the piston, which causes the brigades to move outwards. The air is then exhausted from the outlet port of the 5/2 pneumatic valve.

The purpose of the project is to control the opening and closing of the gate using a pneumatic cylinder arrangement. The gate is always open, but it will close when the pneumatic-operated cylinder is actuated. Compressed air from the compressor is directed to the solenoid valve, which controls the flow of air to the pneumatic cylinder. When the piston is actuated, the gate automatically closes since the piston rod is coupled with one end of the gate. The compressed air is then redirected to the cylinder, which causes the piston rod to actuate, and the cylinder returns to its initial position. The gate is now in an open position.

This gate locking system is used for security purposes and requires less manpower since it is operated using a pneumatic cylinder. The pneumatic operation is faster than other methods, resulting in efficient operation.

7. RESULTS AND DISCUSSION

In conclusion, the modified railway crossing project presented a safe and efficient solution for railway crossing gate operations. The use of pneumatic cylinder arrangement, PU tubes, and DC battery-powered sensors allowed for the automatic opening and closing of the gate, without the need for manual intervention. The I/R sensor and the 5/3 directional control valve provided accurate and reliable sensing and control of the gate’s movement.

The project’s design focused on simplicity, using basic components and straightforward construction, making it easy to install and maintain. Moreover, the use of compressed air as an energy source, along with the efficient pneumatic operation, resulted in a cost-effective and environmentally friendly system.

Overall, the modified railway crossing project provided a robust and reliable solution for railway crossing safety, ensuring the safe passage of vehicles and pedestrians while preventing any potential accidents or mishaps.

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