LINEMEN SAFETY SYSTEM

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Abstract: Overload or short circuit is quite a common problem affecting electrical system and need to be corrected immediately. The function of circuit breaker is used to detect a fault condition and interrupt current flow to protect the system. When compared to fuse, a circuit breaker can be used to find fault in the system and isolate it and after fault has been rectified it is brought to normal operation. The accidental death of lineman has become a common problem which happens due to lack of miscommunication or lack of coordination between lineman and operator. In this work circuit breaker is designed in such a way that only the assigned person can operate it with the personalized password. As a result of implementing this novel method, the safety of the worker can be ensured because the line cannot be energized without his permission.

Index Terms - **Raspberry Pi, relay, pixels, CMOS**

I. INTRODUCTION

In any job that we are engaged safety is the primary concern to work freely. The accidental death of lineman has become a common problem which happens due to lack of miscommunication or lack of coordination between lineman and operator. This paper offers a solution to take care the safety of linemen while working on fault lines. The control of whether to energize the line or not will be maintained by the linemen only. This project is developed in such a way that line man has to provide the password to energize or reenergize a line. This includes image processing and sending the linemen image through mail to the concerned person. When the image is recognized, an OTP is sent to the linemen through GSM. The linemen can now enter the password and switch off the supply to work on the line.

When any problem is detected in electrical line then line man will turn off the electric supply to the line by providing the password and can work on the electrical line without any concerns. Once the work has been completed the line man switch on the supply to the particular line by entering the password and this entire process can be done without any lack of coordination as the chain of responsibility is in the hands of the linemen themselves.

II. LITERATURE SURVEY

This paper discusses the methodology implemented in designing the Lineman Safety System. The increasing accidents in the line of work of utility personnel is worrisome. This calls for measures to improve their working conditions. Thus, a safety system in which the switching is controlled by a password. And as a second layer of safety, a facial recognition system. The system incorporates a Raspberry Pi as the brain of the system. It is through the Raspberry Pi all the signals are received from and sent to. All the communications to and from the system are abetted with a GSM module.

Normally, in the scenario for line maintenance, the line power is switched ON/OFF manually by workers at the substation. As it is the case with all human involved works, there happens human error due to miscommunication. In order to avoid this, the circuit breaker is made to be operated at the will of the lineman. In case the lineman wants to conduct a repair on it, only they will be able to turn it off. Likewise, when a repair is completed, only the lineman will be able to turn it on. In this system, first the facial data of the lineman who is authorized to work is preloaded in the system. When they want to change the switching state, they have their face recognized by the system via means of a camera. An Open CV software is installed in the Raspberry Pi to facilitate this. When the face recognition authorizes the lineman, a confirmation is sent to the higher official.

They then send an OTP (One Time Password) to the lineman for authentication. The lineman enters the OTP, which if entered correctly, changes the switching state of the breaker. Otherwise, an error will be displayed, asking to enter the OTP again. Therefore, here we have a two factor authentication system contributing to increased safety and dependability of the system.

Ergo, the accidents due to miscommunication can be avoided up to a fairly large extent. However, like any technological advance, this system too has its faults. For instance, a weak GSM signal or lack of signal may cause a delay in the switching operation or hinder it completely. Some modifications may also be made to this system so that instead of the OTP, the lineman's biometrics can be included.
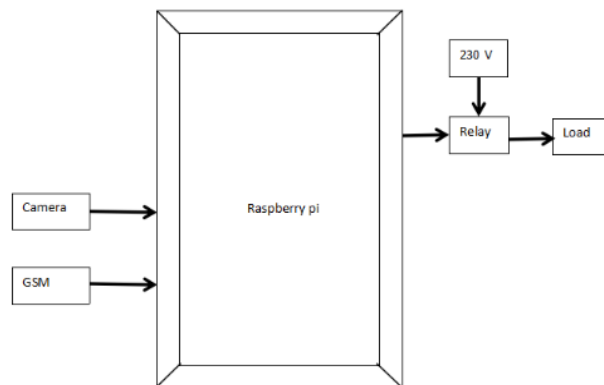
III. BLOCK DIAGRAM

Figure 1: Block Diagram

The block diagram provides the flow of control such that if it is essential to operate the circuit breaker connect or disconnect, a password is required. This method is developed to ensure the life of the lineman and to reduce the fatal electrical accidents to the lineman due to electric shock that is caused when the line under correction is energizing by mistake. This includes image processing and sending the linemen image through mail to the concerned person. The linemen can now enter the password and switch off the supply to work on the line. The line man is entrusted with a password and if he detects any fault in the line he can switch off the power supply by entering password which is only known to him and repair the electrical line, and after coming to the substation line man energizes the supply to the repaired line by giving the password.

According to the program given to the raspberry Pi, relay controls the circuit breaker. The entire system consists of Webcam, GSM module, relay and load. To repair a line, lineman has to request for one-time password. This password is compared with the stored OTP of the device. If the OTP is verified, a secret password is sent to the lineman's mobile number. After completing the repair work he can energize the line. The details of repair work, like information about the lineman and place of repair is sent to the higher authorities so that they can monitor the completion of work.

IV. IMPLEMENTATION

4.1 PICTURE INTO A DIGITAL FORM

When we use a webcam to take a photo, light enters into the lens. When this picture reaches the image sensor, it is broken up into individual pixels. These pixels are converted into numeric form. The two types of CCDs and CMOS chips do this in slightly different ways. Both uses photo electric effect to convert incoming light rays into electricity. For digitizing, a CCD uses an analog optical chip to convert light into varying electrical signal. These signals are then passed on to one or more other chips where they're digitized. On the other hand, a CMOS chip does everything in one single chip. So CMOS is a digital device when a CCD is analog. CMOS chips has faster operation and is not expensive when made in bulk but CCDs, find application in most low-cost cell phone cameras and webcams.

Irrespective of whether the image is captured by CMOS or CCD the process of conversion is the same. The incoming image is digitized into a pattern. The first component is image sensor. Initially the image sensor quantifies the potency of light entering at each pixel. This pixel information is converted to a number and is stored on a memory chip fixed inside the camera. A picture is converted to long string of number while taking a digital photograph. Each number gives an information about how bright or dark and what color it is.

4.2 RELAY

A relay is a simple switch that works on the principle of electromagnetic induction. Relays is meant to disconnect from one circuit to other which are completely independent to each other. The magnetic field created when current flows though the coil attracts an armature which is mechanically connected to a moving contact. The movement either connects or disconnects the circuit with a fixed contact. When the current is reduced to minimum, the armature returns back to its initial position with a force half as strong as the magnetic force to its relaxed position.
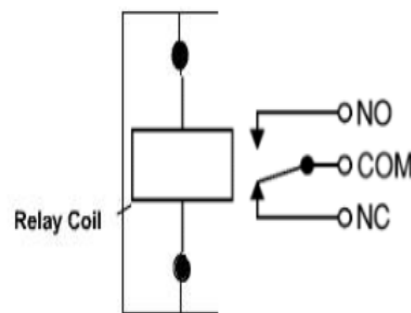

Figure 2: Circuit symbol for relay

4.3 DRIVE CIRCUITS AND PROTECTION DIODES FOR RELAY

Typically, a large current passes through the coil of a relay and say for example, 100mA for relays which are designed to operate on low voltages. ACB amplifier is used to protect the relay from exceeding the rated current value. Protection from over voltage must be provided to transistors and ICs when a relay coil is switched off. A normal diode (e.g. 1N4148) is connected in reverse biased mode across the relay coil to ensure no overvoltage appears across this coils. The magnetic field created in the relay coil crumbles suddenly when the current in the coil becomes zero. This disintegration of the magnetic field develops an overvoltage across the relay coil which is sufficient enough to impair the transistors and ICs. The protection diode bypasses this overvoltage to produce a small current through the coil (and diode) so the magnetic field does not collapse rapidly. This protects transistors and ICs from over voltage developed when the magnetic field collapses instantly.
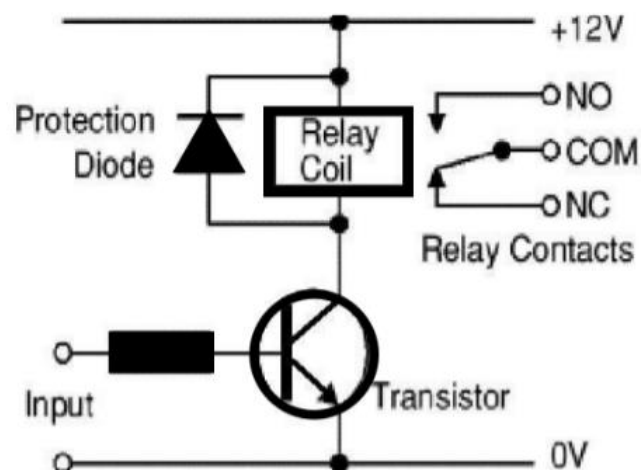

Figure 3: Drive circuits and protection diodes

V. METHODOLOGY

For LT system maintenance, first the overseer has to grant permission to work. The normal procedure is, first the overseer turns off the switch or disconnects the fuse in the substation and commands the lineman to work. The lineman goes to the distribution transformer of the work site and earths both sides of the power line. Then they ensure that current does not flow through it by shorting the conductors. But nowadays, linemen ignore all these steps and proceed directly to the work.

The face of the lineman is scanned each time he comes for work. If it the designated person a message is send to superior for confirmation. Once the superior confirms it a password is send to the lineman. Then the keyboard is enabled for the password entry. If the password is verified the line is energized or deenergized.

An image captured by the webcam consist of number of elements known as pixels. The resolution of any image is determined by number of pixels in that image. Greater is the number of pixel, higher is the resolution. Each pixel in the image is digitized depending on the colour conversion used. To compare two images, the digital values of two images are taken and compared. The pixel in the half way position is taken as reference. Pixel surrounding it is compared with the reference. Pixel greater than the reference is set as high or digital 1 and the ones less than reference is taken as low or digital 0.

VI.   HARDWARE DESCRIPTION

The components used in the hardware includes:
- Raspberry Pi 3 Model B+
- GSM SIM 800L (3.4 V to 4.4V)
- Relay : SPDT, single channel, 5V
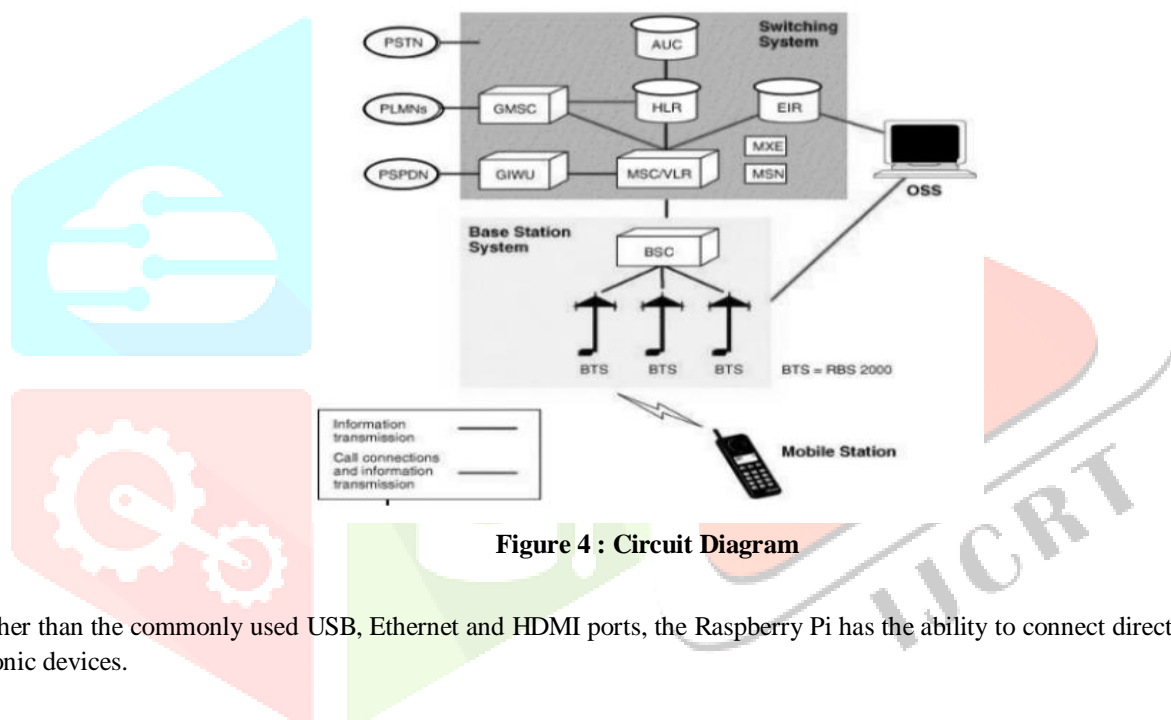- Webcam : 480P USB powered

Figure 4 : Circuit Diagram

Other than the commonly used USB, Ethernet and HDMI ports, the Raspberry Pi has the ability to connect directly to different electronic devices.
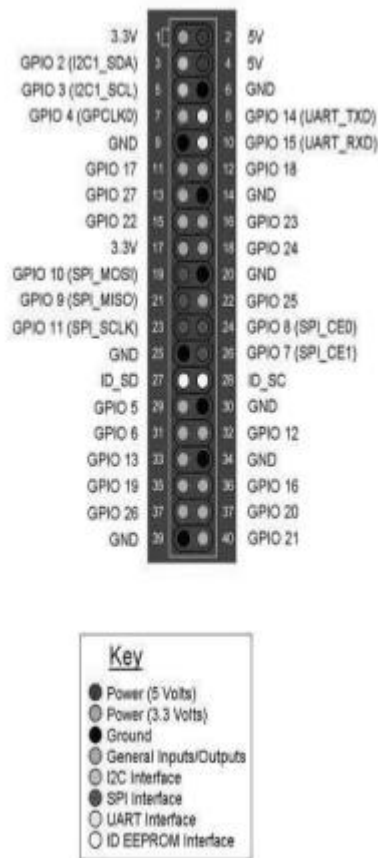
6.1 GENERAL PURPOSE INPUT-OUTPUT PINS

Figure 5: Pin Diagram

GPIO can withstand voltage levels of 3.3 V but is intolerant to 5 V. This board does not provide any over-voltage protection. Those people who are in need to interface should use an additional board with buffers, level conversion and analog I/O. The detailed functions of each pin are provided in the datasheet of the chip. That pins 0-27 of the chip are in the same block therefore the functions are set as blocks not as pins. Utmost care must be taken with the 5V pins P1-02 and P1-04, because at any point if it is short circuited to any other P1 pin it will permanently damage Raspberry Pi. Hence it is better to connect short pieces of insulation wires to P1 to provide insulation so that it will not get short circuited to 5V pins.

6.2 EMBEDDED SYSTEMS

In order to perform real time functions, embedded system is used. Embedded systems consist of hardware and mechanical parts and are embedded as a part of device. When compared to a commonly used computer embedded systems can do many different tasks depending on how it is programmed. Embedded systems have gained lot of importance in present days as they are used in all common devices.

Depending upon the application for which the embedded system is designed for, design engineers can reduce the size, cost and also increase reliability and overall performance. To take in the advantage of reduced cost they are produced in bulk rather than in small scale.

Size of embedded systems can vary from as small as used in digital watches to as large as used in applications like traffic light, or even for controlling power plants. Depending upon the application embedded systems has been used for its complexity also varies accordingly from a single chip to multiple chips connected together.
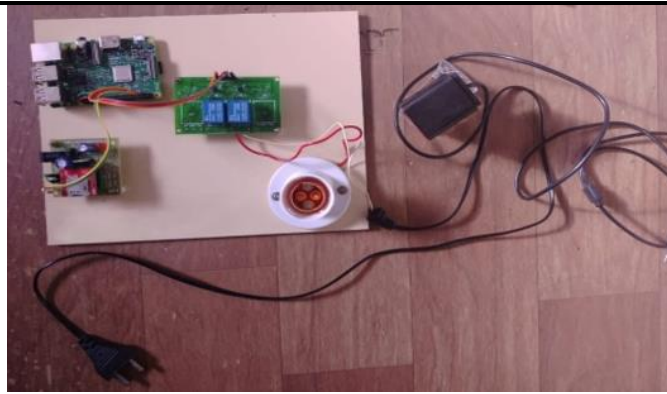
Figure 6: Hardware Set up

VII.   CONCLUSION

This paper aims to develop a protection system for lineman to work safely on electric lines during a fault. This novel system ensures that only lineman can energize or reenergize the line thereby security can be assured. It is extremely useful and not an expensive method. The system works on a password which only the operator is aware of. Hence security of the lineman will not be a problem. This lineman protection system can hence reduce the number of death rates happening because of miscommunication between people. Once the fault on the line has rectified, the supply can be restored with the help of the unique password.

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