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Industrial Production Line Safety and Management System Using Sensory Unit and Image Detection

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***Abstract*--- Industries are one of the major factors responsible for economic growth of country and also provides huge employment opportunities for skilled labors. Normally Industry is established on very large Scale of land which measures in acres. The manufacturing unit involves many production line sections working together day and night to produce very huge quantity of products. In a large industry hundred and thousands of machines are installed in production line sections and each machine is operated by an operator. In this type of situation, it is very difficult to monitor each and every operator whose safety is a major concern which is neglected due to huge number of machine operator working together in rotational shift timing. The major aspects what we are up to in our project regarding industrial production line safety are labors consume alcohol during the working in the campus using a alcohol sensor, Position detection of employee in vast industry in major needs using transmitter and receiver, Emergency alert system using a panic key to alert the authority immediately, Power monitoring unit of machinery to make sure there is no wastage of power unnecessarily and operator occupancy test using Pi-camera for the automatic shutdown of the machine in absence of the employee.**

***Keywords*--- Raspberry Pi, alcohol sensor, RF transmitter, R F Receiver, Step-down Transformer, Bridge, Rectifier, Pi-camera, Transformer, Cloud (Drop box)**

I. INTRODUCTION

We develop a technology-based solution for the above problems faced in industries using sensory unit and image processing. Where we continuously conduct a safety test of each and every machine operator and also monitor them during working hours by transmitting all the monitoring parameters of each and every employee or operator to the central online server where database is maintained and a single person can monitor huge number of operators by accessing all the data from central server Drop box.

II. EXISTING SYSTEM

In real time, when we consider large industrial area to detect presents of operator in front of the machine this concept is not yet in process due to which it causes power wastage issues to the industry therefore using pi camera and current sensor this concept is proposed. However, the position location of the employee at a height requirement is very different in vast industrial areas therefore by using RF transmitter and receiver the location detection is done in the proposed system. In cars we have alcohol detection concept for vehicle automatic shut down when detection of alcohol is done to overcome the accidents that occur on road. The same concept is proposed in large industries for automatic shutdown of machine if alcohol is detected and in emergency situation, when a panic key is pressed there is no concept of immediate alert message sent to the high authority therefore immediate alert is proposed.

III. THE PROPOSED SYSTEM

Figure 1 shows the proposed system architecture, which includes the Raspberry Pi controller as the primary source for receiving input signals from the sensors so that the sensors receive input signals for the Industrial Safety purpose .In this case, The sensors described in this architecture are Alcohol Sensor, step down transformer, bridge rectifier and components are Panic key, Buzzer, 2 relay, DC Motor, RF Receiver with 2 nodes followed by cloud were drop box is used for storing data of the Operator Zone Update and in Figure 2 includes RF Transmitter and Battery of 9volts for Employee position locator setup.

IV. WORKING PRINCIPLE

The proposed concept involves 5 major modules to provide technology-based safety and monitoring solution in production line unit of the industry.

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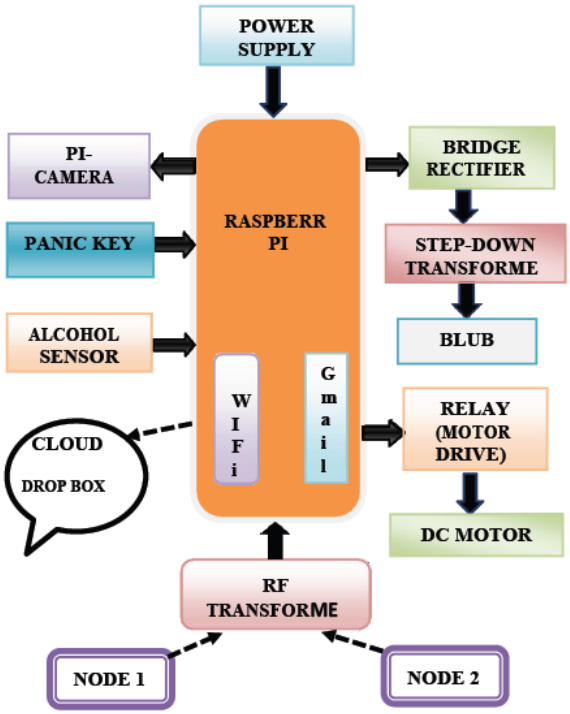

Figure 1: Operator Zone Update

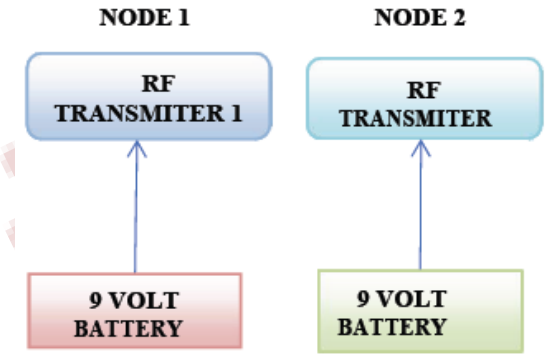

Figure 2: Employee Position Locator Setup

Operator Occupancy test unit: Machine Operator zone is installed with Pi camera unit which is used to detect the presence of machine operator. This is used to detect the human face when an operator occupies his operating zone ,when human face is not detected for some period of time then machinery will automatically turn off to save power, at the same time it will send the real time occupancy report to the central online server using IOT technology.

Alcohol Intoxicant test in operator zone : When alcohol traces are found by the sensor before starting the machine then the machinery will not start at first instant, but when alcohol is consumed during machine operation period then immediately the machinery will stop to avoid accidents then it is sent to online central server and is notified to the Industry Management App.

Power Monitoring unit of machinery: To monitor the machine state i.e. ON/OFF we use current sensor which keeps a sense on machine ON/OFF Status. This status is continuously updated in online central server (cloud) from where data can be accessed by Industrial management App this is done because operators will turn off the machinery during working hours for no reason which cause huge loss to industry output.

Operators Emergency Alert System: A Panic Key is placed near every machine inside the operator zone so that operator can press the button immediately when panic situation occurs, A notification is provided on the industrial management app using IOT technology where maintenance authority can reach for help and also a loud buzzer alert is provided near the machinery so that co-workers can come for rescue.

Employee position tracking: when the industry is spread in wide area then locating the employee is difficult during working hours. By using the signal strength concept between both transmitter and receiver we locate the position of person within the campus were each employee is given with the Transmitter this acts as a wireless communication.

V. HARDWARE DESCRIPTION

1) RASPBERRY PI 3 B+: It is a collection small sized card whose measurement can be contrast with saving card that generally plugs into a TV and laptop monitor. It is based totally on an ARM cortex A53 structure , CPU is speed to 1.4GHz from the speed 1.2GHz in the authentic mannequin B, and enlarge of 16.7%.A most throughput of the model B's Pi 3 is 2.4GHz 802.11n of WI-FI is tripled through the addition of 802.11AC WI-FI. It approves Bluetooth 4.2. Python is a programming language which is used in interfacing of Raspberry-Pi.

Figure 3: Raspberry pi 3 B+

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2) ALCOHOL SENSORS(MQ-303A): It is a semiconductor sensor type, concentration of alcohol sensor is 20- 1000ppm, heat voltage is about 0.9v+_v AC or DC, loop voltage is greater than equal to 6v dc. Alcohol sensor is of tine dioxide totally based semiconductor gas sensor which indicates excessive sensitivity to alcohol in a brief span. This model is exceptional used as transportable breath alcohol checker for alcohol detection or ignition locking gadget in automobiles. As resistance of the sensor detects preheating it enter into stable condition. whereas its stability reduces when gas concentration increases in working electrified, load resistance is adjustable. It has Low power consumption, speedy response, Higher sensitivity, perennial, inexpensive and Minimum dimension are the promising facets of alcohol sensors.

Figure 4: Alcohol Sensor (MQ-303A)

3) DC MOTOR: NR-DC-ECO is a motor DC machinery with standard attribute and lowprice. Motor operates on a 1.5V or up to 100V or more. The long durability and better depletion characteristics of DC motor are ensured by its brass gears and steel pinions, which are fixed on hardened mirror polished steel spindled Bronze plates ensure silent running between spindles rotate. The plastic ring covers this whole assembly.

Figure 5: DC Motor

4) BUZZER: To insert the audio characteristic to the task a small but efficient component is used which is however known as buzzer. Applied voltage is 6v Direct current, running voltage is 4 to 8 voltage DC, power rate is greater than 30Ma, Resonant Frequency is approximately 2300 Hz. It is a two pin shaped which is diminutive and dense as a result without problem it can be used on bread board even on PCB. This feature of buzzer makes it extensive used factor in most of the digital applications. The under proven discern is a easy buzzer that makes non-stop beep when power is ON.

Figure 6: Buzzer

5) PANIC SWITCH: A panic alarm is a digital gadget used in emergency condition, the place a change to people or property exists to help someone by means of alerting them. Electrical ranking 230volt alternate current/direct current 4 Amp, current 0.5A and 1A. Via a silent alarm or an audible bell, these buttons can be linked to a monitoring center. Emergency help from police neighborhood protection or emergency offering can be requested by way of the use of such alarm buttons.

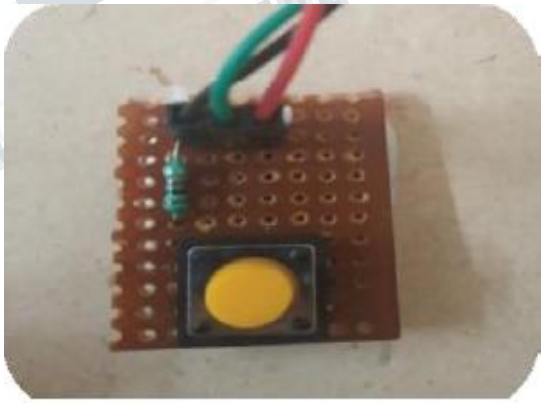

Figure 7: Panic switch

6) BATTERY(9V): Alkaline and carbon-zinc are primarily commonly available, in principal lithium iron disulfide and rechargeable shape of nickel, cadmium, lithium-ion. Batteries had been used very frequent, however currently they are now not being manufactured due to presence of mercury.

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Figure 8: Battery (9volt)

7) RELAY

Resistance of Insulation	Minimum IR is present 100M at the rate of 500VDC.
Strength of Dielectric	Its rate is 750volt alternate current and time of 1min allying of open contacts with 1,500volt ac followed by 1min Allying contacts and coil
Count of Operation	Maximum of 8 millisecond
Count of Release	Maximum of 5milisec
Temperature	-30 to +85 ••
Shock Resistance	10G
Resistance of Vibration	-55Hz, 1.5mm Amplitude
Weight	gr.

Figure 9: Relay

8) RF TRANSMITTER: The controller and the robot module used in both RF transmitter and receiver. The two Rf transmitter and receiver operate on a frequency of 433MHz, a transmitterand- receiver-module, where as it works at the frequency of 316MHz in the robot module and in the controller.

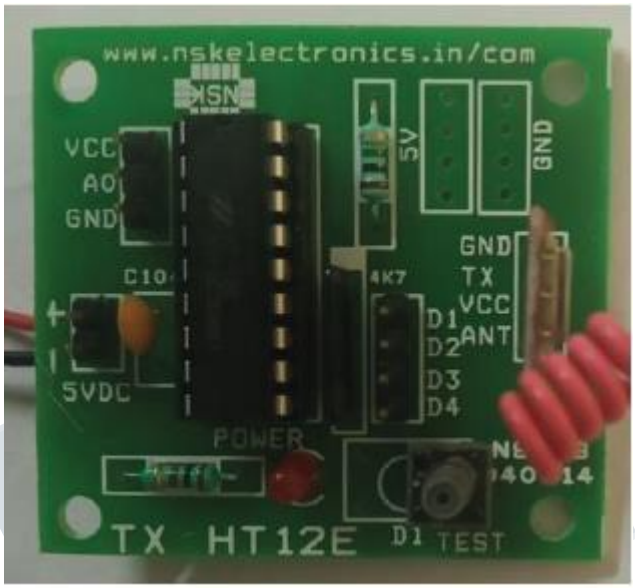

Figure 10: RF Transmitter TWS 434

9) RF RECEIVER: The distance related information transmitted by the robotic module is received by the RF receiver present in the transmitter module. This distance related information is displayed on the LCD module by using micro-controller. The various functions of the robot are controlled by the receiver present in the robotic module which receives the control signal transmitted by the control unit.

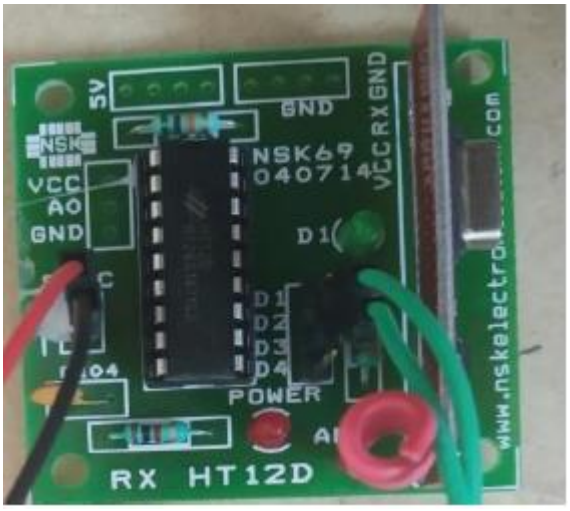

Figure 11: RF Receiver RWS 434

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10) PI CAMERA: This is 5 mega pixel digital camera module successful of taking pictures clear and sharp nevertheless image and action video, it works nicely with each laptop computer and desktop computers. It works well with both laptop and desktop computers. The captured information is directly connected to Raspberry Pi this connection includes ribbon cable to the Camera Serial Interface port of Raspberry Pi. To get a good quality picture in 5 Mega Pixel digicam photograph sensor high best CMOS sensor photograph manage shade saturation sharpness and brightness are adjustable and snap shot swap is used for taking nonetheless picture..

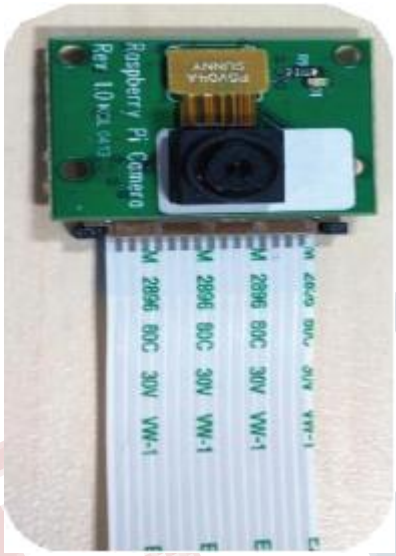

Figure 12: Camera Interfacing

11) BRIDGE RECTIFIERS: An alternate current input is converted into direct current output, most often by using a bridge rectifier (specific arrangement of diodes) . Bridge rectifier are present in almost all types of electronics which require direct current.

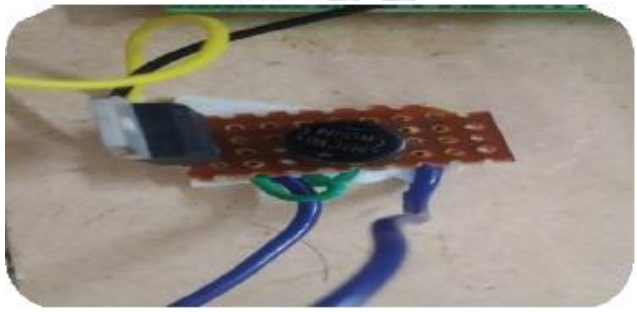

Figure 13: Bridge Rectifier

12) STEP DOWN TRANSFORMER: The excessive voltage present at the primary winding is decreased to low voltage at the secondary winding by the usage of step-down transformer, the quality of turns in primary winding of step down transformer is greater than secondary winding, the typical image of a step down transformer is as shown below. It is mainly used to reduce the main supply voltage to required voltage level. Whether it be a big distribution transformer or a small transformer, purpose is the same. The big distribution transformer step downs the distribution voltage 11 KV up to 220/440 V and this step downed AC is supplied to over homes (in India).

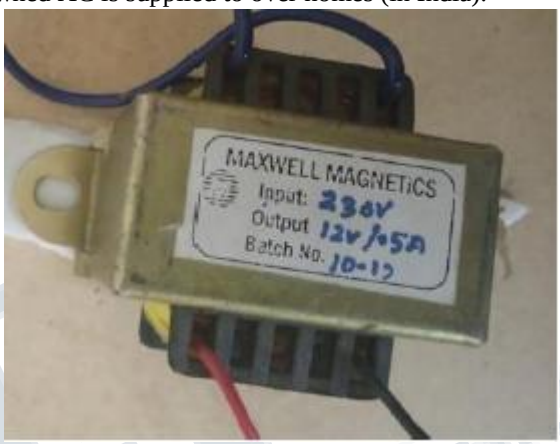

Figure 14: Step down Transformer

13) BULB: Bulb is a device which converts electric energy in to light form of energy by sending current via filament thin wire. Most commonly tungsten metal is used as filament material due to its higher melting point. The bulb flows when filament get heated and current flows through it, Eventually the filament gets hotter and hotter by producing light.

Figure 15: BULB

VI. SOFTWARE REQUIREMENTS

SD formatter, Win32diskimager, Advanced IP Scanner, Putty Software, Drop box (app).

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VII. BRIFE PROCESS EXPLANIATION OF EXPERIMENTAL RESULTS

The Figure 16 shows the setup system of security and safety measurements of employees in large industry for the following methodologies: Operator occupancy test unit, alcohol intoxicant test in operator zone, power monitoring unit of machinery, operators emergency alert system, employee position tracking.

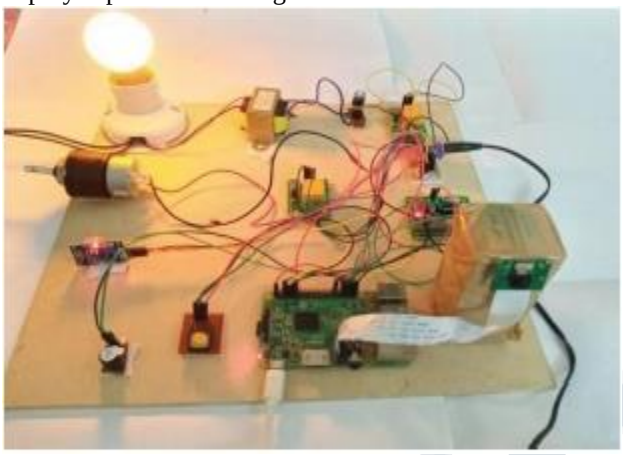

Figure 16: Setup of Employment safety using sensors and Raspberry- pi

The working process and expected results for all the 5 methodology are as follows: 1)Alcohol Intoxicant test in operator zone:

Figure 17: Alcohol detection setup (MQ3 alcohol sensor)

The figure 17 shows the process of alcohol sensor. To detect consumption of alcohol for the safety of employee, a digital alcohol sensor is used and a DC motor is considered as a machine to show the automatic shut down when alcohol is detected. Alcohol contains ethanol gas , when cotton is dipped with alcohol and positioned closed to the sensor ,it identifies the attentiveness of alcoholic gas.As soon as it detects the alcohol a green LED light on the MQ3 alcohol sensor will blink and the DC motor will get turned OFF automatically and a message stating" operator is drunk" is sent to the authority using cloud concept were a data base is maintained using a Drop box as shown in output 1.

OUTPUT 1

2) Operators emergency alert system:

Figure 18: Setup of operator emergency alert system

The above figure 18 shows the process of emergency alert. Over here a panic key is used it works on 3.3v which is interfaced on Raspberry-Pi by following GPIO pin configuration. A buzzer is used to alert using a sound beep. When a short circuit or any serious issue occurs in the operator zone, the operator presses the panic key and the buzzer beeps immediately. In case of any emergency like health issue of the employee the other present employee in the operator zone will press the panic key and an alert message stating "emergency! operator needs attention" will be sent to the authority as shown in output 2 and an immediate action can be taken.

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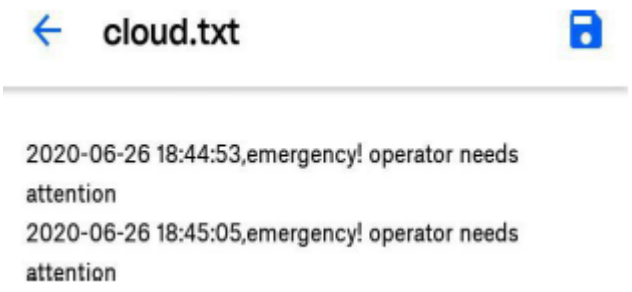
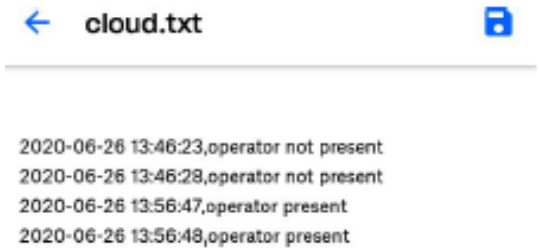


OUTPUT 2

3) Operator occupancy test unit:

Figure 19: Set up of operator occupancy unit:

The above figure 19 shows the process of operator occupancy , over here we have used a Pi camera that supports the raspberry pi using MISI (Mobile Industry Processor Interface)camera serial interface, it is a widely adopted due to its simplicity high speed protocol. And it is primarily intended for point to point detection between camera and host..The Pi- camera is fixed to the machine interfaced with the raspberry pi, here we are using mail concept , a device mail id will be created and when the authority member wants to check the status of occupancy then he will send a mail message code to the device id , when the face of the operator is not detected in some given time delay then the motor will get OFF automatically and the authority member will get a message to the drop box stating "Operator not present " and to check if the operator is present the authority member will send the mail code. When the face is detected a message stating " Operator present" will be sent to the authority as shown in output 3.

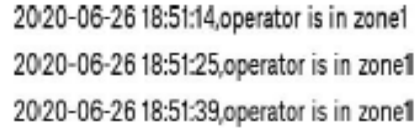


OUTPUT 3

4) Employee Position Tracking

Figure 20: Setup of employee potion tracking

In the above figure 20 process of employee position tracking is shown. here we have used a single RF receiver and two RF transmitter, over here to make it easy we have divided the 2 transmitters in to node 1 and node 2. Each transmitter is attached to the 9v battery. the authority member acts as the receiver so the RF receiver is fixed in the authority zone and the RF receiver device will be with the individual employee it can be a wearable device. when the authority wants a particular person potion in the vast industry in any necessary needed condition, over here Gmail concept is used, the authority member will send the mail code as a message to the divide mail id as soon the transmitter receives the mail it will send a message stating operator is in node 1 or node 2 as shown in output 4.



OUTPUT 4

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5) Power monitoring unit

Figure 21: Set up for Power Unit Monitoring in machine ON condition

Figure 22: Set up for Power Unit Monitoring in machine OFF condition

The above figures 21 and 22 shows the ON and OFF status of the machine. If the authority wants to know whether the machines are in OFF or ON condition in working hours this methodology is used. If the machine is OFF in the working hours in any production line industries it may lead loss to the industries in the quantity of production output. To show this methodology we have considered the machine as a bulb. A step-down transformer is connected to the bulb, we get 230volts from the main supply the transformer will step down that in to 12 volts and convert AC in to DC and give that 12volts to the bridge rectifier which is parallelly connected. The bridge rectifier will then convert the 12v in to 5 volts DC and it is given to the relay were the relay converts the DC to AC again and gives 5v to the raspberry Pi. When the authority wants to know the OFF and ON condition, he will send a mail message code to the device mail id. when the machine is ON that is as shown in the fig 21. If the bulb is ON then the message is sent to the authority as " POWER ON" , in case if there is no current consume as shown in figure 22 then a message will be generated to the authority as " no power " through the drop box as shown in output 5.

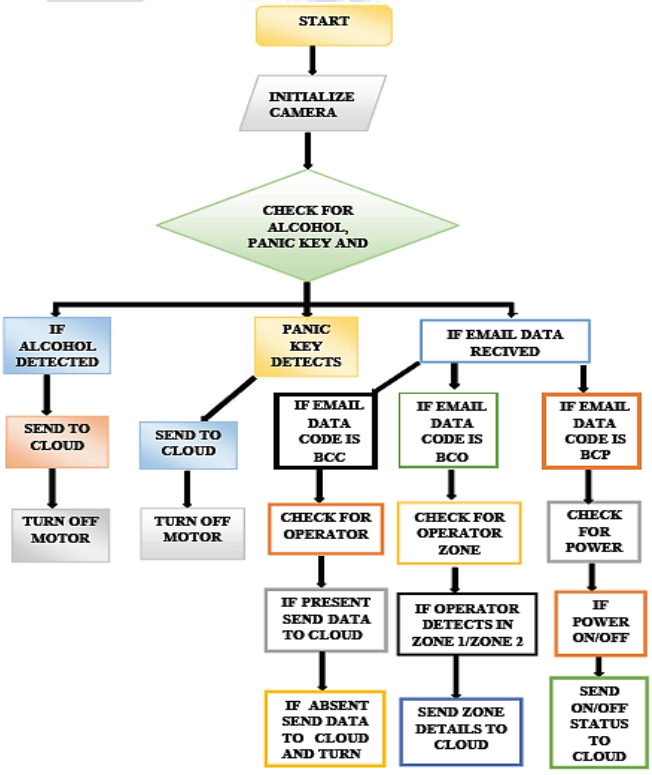
2020-06-26 19:07:25,NO POWER
2020-06-26 19:07:26,NO POWER
2020-06-26 19:08:02,POWER ON
2020-06-26 19:08:25,POWER ON

OUTPUT 5

VIII. CONCLUSION AND FUTURESCOPE

This paper shows the security and safety of a Research and Development system for employees in industrial production line. we have successfully tested the output by implementing Raspberry Pi, alcohol sensor, RF transmitter, RF receiver, pi- camera, step-down transformer, bridge rectifier, Relay for different methodologies for the security management system of employees. For further advancement, it can be analyzed that for high security purpose the body language with facial recognition is used. It must be highly automated so that it cannot fail. The reliability of Raspberry Pi is compatible, so that we can use the system faster. This technique shows the all over safety purpose of the employee in large industries.

IX. FLOW CHART OF THE METHODOLOGIES:



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