International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 07 | July 2022 www.irjet.net p-ISSN: 2395-0072

Internet of Things (Iot) Kit for Human Head Safety in Construction Project

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Abstract - *We know that India is in the list of developing countries. As in developing phase the nation is moving towards infrastructural and urbanization development. The both directly lead to increase in construction activities. Approximately 150+ employee caught in accidents out of 1000 in India. The mass employee at site is difficult to manage with regards to safety norms and regulations. So Wearable Sensing Devices (WSD) and the Internet of Things (IoT) have been identified as emerging technologies with great potential to managing and coordinating the mass. On construction sites. Wearable sensors and systems can be used for physiological monitoring, environmental sensing, proximity sensing, and location tracking of a wide range to restrict the construction hazards. Based on the results of the completed review, recommendations are made on how WSD and IoT can be effectively implemented to improve safety performance on construction sites. There are not much products designed at present to reduce the number of deaths on the construction site, so our work will be one in a kind. In this work an attempt has been made to design IoT based head safety kit for the construction workers. Kit is equipped with the GPS (Global Positioning System) Sensor to track the location of employee of job and Infrared (IR) Sensor to determine the status of worker wearing the head safety cap.*

Keywords: *- Wearable Sensing Devices (WSD), Internet of Things (IoT), GPS (Global Positioning System) Sensor, Infrared (IR) Sensor*

1. INTRODUCTION

The Internet of Things or IoT is the placement of related personal computers, electronic and computing devices, objects, creatures, or people. Equipped with a unique identifier (UID), you can send information about your organization without the need for personal or PC intervention.

Innovative progress has recently evolved dramatically. Finding the right data anytime, anywhere today is very easy. Customers of smart devices can use these gadgets to access large amounts of data from anywhere on the Internet. The Internet of Things allows ordinary objects to communicate with the PC gadgets embedded in them. The long-term benefits of sophisticated gadgets and stages that control machines may include energy reserves. The most well-known scratches in the work environment are slips, power outages and accidents. To solve these problems, IoT is currently used in the development business. Gadgets and sensors embedded in the development materials allow the chief to track and verify ship status via GPS, identify work examples, inactivity times, and other measurements, misuse, robbery, or fuel robbery. In a work environment that helps you avoid the problem and make preparations and mappings successful, taking into account the ever-changing factors. Aid workers are protected by the IoT through wearable devices that check their body and health and provide persistent data. Send alerts when dangerous / dangerous areas are approaching to notify site administrators of unexpected site changes so that you can better monitor your work efficiency.

The new worldview of innovation, often referred to as the Internet of Things (IoT), is normal for some businesses and affects both modern practice and normal human existence. The IoT will support the evolution from a PC organization to an object organization. Here, coolers, machines, clothing, everything in everyday life and work has its own computerized personality and can communicate with external frameworks. Disassemble. .. Customers also criticize. The goal of this innovation is to provide people with programmed data in conjunction with the object by adding "highlights" to the object. These are often referred to as smart objects (SOs). SO can adapt to data and climate based on certain potential advances. Development can be achieved by making SO-based connections in advanced areas. This framework (SO-based computational level) can be a valuable tool to help manage and control word-based security. Over the past few years, IoT innovation has been adopted to enable boards to run in complex frameworks that are tests for both scientists and organizations. You can take advantage of various IoT advances to control power security. B. Radio frequency identification (RFID) and Bluetooth Low Energy (BLE), wearable, sensor organization, etc.

1.1 Aim

To make an IoT Based Kit for human head Safety.

1.2 Objectives

1. To collect and study IoT in various sectors of construction.

2. To construct IoT based Kit for head safety in construction industry.

3. To suggest IoT based safety sensors for head safety tool.

2. Literature Survey

1. A successful structure that adheres to the board framework is expected to limit the damage caused by uncertain structural risks.

2. India's development workforce accounts for 7.5% of the world's total workforce and 16.4% of the world's fatal language-related accidents.

3. In the development business, the risk of serious physical problems is more than doubled, but the chances of an accident are many times higher than in the assembly industry.

4. India has the highest failure rate in the world among development workers, according to a new report from the International Labor Organization (ILO). This is done by 165 out of 1,000 professionals.

5. Accident victims are not only development workers, but society as a whole, including young people.

6. For the second consecutive year (2013 and 2014), the development of the Mumbai Airport Terminal has killed a total of nine workers.

7. Last December, when the foundation of the structure was being dug up, mud rushed in and three workers were dead.

8. Eight workers in Orissa were injured after a slight collapse of an undeveloped three-story building in Tech Park.

9. In October 2016, a five-story building collapsed on a veranda, killing six workers and injuring many. Investigation revealed that the owner ignored the approved plan requiring two floors and additional floors. The property is 1,900 sq. ft. and the building area is 4,300 sq. ft. They have not fully tested the carrying capacity of the soil.

10. According to OSHA, one-fifth of US workers' passports are engaged in development projects

11. Around 42 crane-related migrations per year, about 60% are related to falling objects as per BLS

12. In 2020, a total of 1,008 development workers gave up their jobs.

13. Each year, 10.2 out of 100,000 development workers experience fatal physical problems, the third highest in any industry.

14. Falls account for 16.9 % of all developmental assaults – eradicating developing falls will save more than 300 lives on a regular basis. [BLS]

15. As per study by Ramesh Kumar BeheraaMd and Izhar Hassanb in their work titled "Regulatory interventions and industrial accidents: A case from India for 'Vision Zero' goals" states the following statistical data :

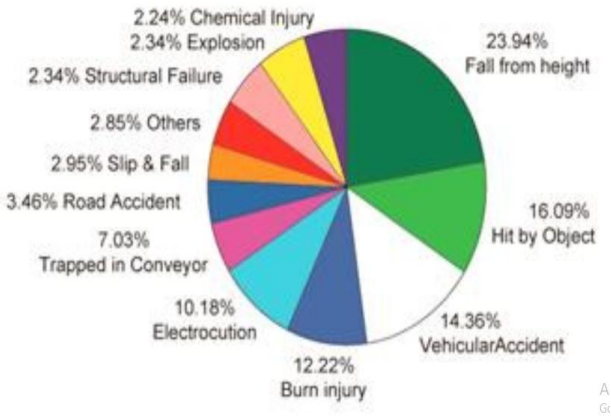
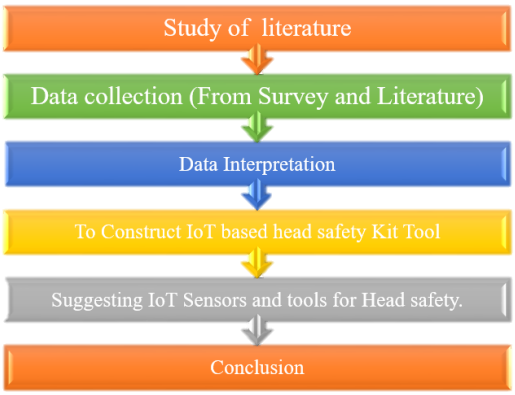


Fig 1: Type of Fatal Accident (2001-2016) [29]

16. From above statics hit by object ranks 2nd in total accidents happened so I have chosen these as area of work.

3. METHODOLOGY



We ha ve conducted a survey to collect the data related to IoT and role of Iot in Various phases of construction project (i.e. Initiation, Planning, Execution and closing). The questions and RII ranking of each are as followed.

3.1 Questioner Survey

Following are the questions in Section 1

1) Name

2) Designation

3) Experience (Years)

4) Do you think IoT team management is a good option?

5) The interdisciplinary teams are hard to manage.

6) IoT based projects are more conflict prone

7) Team-work skill set is an asset on a loT project

Following are the questions in Section 2

In these section the following parameters for each Initiation, Planning, Execution and closing:-

1. Cost
2. Schedule
3. Scope Creep
4. Conflicts
5. Vendor Management
6. Risk

3.2 Relative Importance Index and Ranking

Relative Importance Index=∑w/ (A*N) = 5n5+4n4+3n3+2n2+1n1 / (A*N)

Where w is the weight of the respondent for each element. In this case, the ranking is from 1 to 5. Where n5 is the number of "insignificant" respondents, n4 is the number of "less important" respondents, and n3 is the number of "medium importance" respondents. n2 represents the number of "important" respondents and n1 represents the number of "very important" respondents. In this case, 5 is A, which is the total number of people marked N.

Phase	Parameter	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Total	RII	Rank
Initiation	Cost	3	7	10	19	7	46	0.51304	5
	Schedule	4	4	14	13	11	46	0.50000	6
	Scope Creep	3	9	14	10	10	46	0.53478	2
	Conflict	3	8	17	12	6	46	0.55652	1
	Vendor Management	4	7	13	14	8	46	0.53478	3
	Risk	3	3	18	16	6	46	0.51739	4
Planing	Cost	4	4	13	16	9	46	0.50435	5
	Schedule	3	7	15	16	5	46	0.54348	1
	Scope Creep	3	5	16	15	7	46	0.52174	3
	Conflict	3	5	18	15	5	46	0.53913	2
	Vendor Management	3	4	14	18	7	46	0.50435	4
	Risk	3	3	13	18	9	46	0.48261	6
Execution	Cost	2	7	19	9	9	46	0.53043	1
	Schedule	4	2	18	17	5	46	0.52609	2
	Scope Creep	2	6	16	17	5	46	0.52609	3
	Conflict	3	3	17	16	7	46	0.50870	4
	Vendor Management	4	2	16	15	9	46	0.50000	5
	Risk	3	3	17	16	7	46	0.50870	6
Closing	Cost	4	5	16	15	6	46	0.53913	5
	Schedule	3	6	19	13	5	46	0.55217	4
	Scope Creep	3	4	20	14	5	46	0.53913	6
	Conflict	3	8	16	13	6	46	0.55217	3
	Vendor Management	4	5	20	13	4	46	0.56522	1
	Risk	5	6	14	16	5	46	0.55652	2

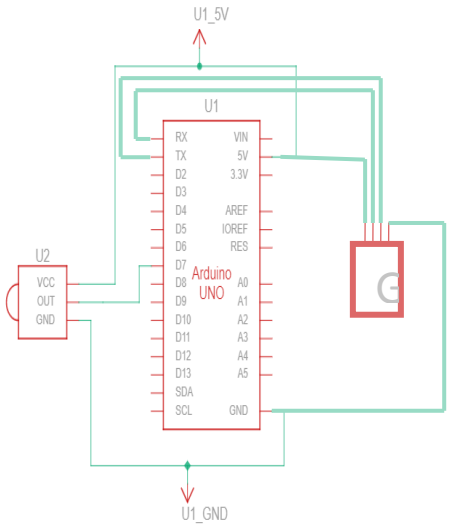
Table 1: RII Ranking

4. CONSTRUCTION

4.1 Construction of Head Safety IoT Kit

4.1.1 Equipment and Sensors

1. Arduino UNO (Microcontroller)
2. IR Sensor
3. GPS Module (Neo 6M)
4. Bread Board
5. Connection Wires and cables



4.1.2 Code and Execution

GPS Code

```
#include <LiquidCrystal.h>
#include <SoftwareSerial.h>
#include <TinyGPS.h>
float lat = 28.5458,lon = 77.1703;
SoftwareSerial gpsSerial(3,4);//rx,tx
LiquidCrystal lcd(A0,A1,A2,A3,A4,A5);
TinyGPS gps;
void setup(){
Serial.begin(9600);
gpsSerial.begin(9600);
lcd.begin(16,2);
}
 void loop(){
 while(gpsSerial.available()){
 if(gps.encode(gpsSerial.read()))
 {
 gps.f_get_position(&lat,&lon);
 lcd.clear();
 lcd.setCursor(1,0);
 lcd.print("GPS Signal");
 lcd.setCursor(1,0);
 lcd.print("LAT:");
 lcd.setCursor(5,0);
 lcd.print(lat);
  lcd.setCursor(0,1);
 lcd.print(",LON:");
 lcd.setCursor(5,1);
 lcd.print(lon);
 }
}
String latitude = String(lat,6);
 String longitude = String(lon,6);
Serial.println(latitude+";"+longitude);
delay(1000);
```

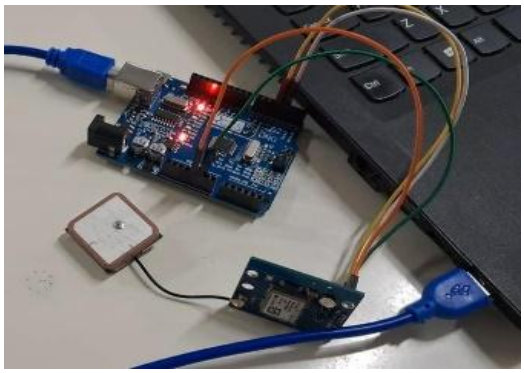


Fig 3: Arduino with GPS

IR Sensor Code

ir_and_buzzer §

```
int IRSensor = 7; // connect ir sensor to arduino pin 7
int LED = 13; // conect Led to arduino pin 13



void setup()
{



  pinMode (IRSensor, INPUT); // sensor pin INPUT
  pinMode (LED, OUTPUT); // Led pin OUTPUT
}

void loop()
{
  int statusSensor = digitalRead (IRSensor);

  if (statusSensor == 1)

   digitalWrite(LED, HIGH); // LED High

  else
  {

   digitalWrite(LED, LOW); // LED LOW
  }

}
```

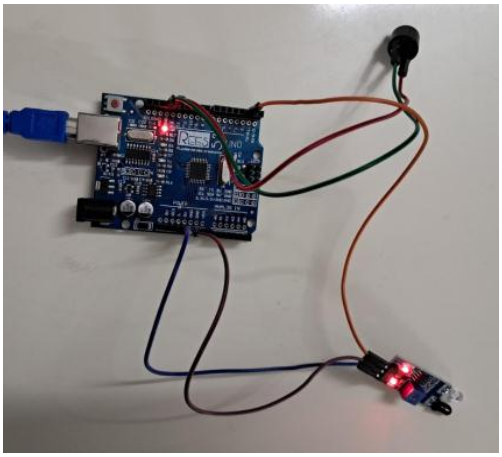


Fig 4: Arduino with IR

4.1.3 Cost of Construction of Kit

Table 2: Construction Cost

Sr.No	Item Name	Cost (in Rs)
1	Arduino UNO	550
2	IR Sensor	60
3	GPS Module (Neo 6M)	275
4	Bread Board	50
5	Connection Wires and cables	100
	Total	1035

4.2 Sensors and Tools

The study is of various sensors that can be used in IoT based models and are divided into 3 categories on the basis of their use in construction industry. The 3 groups are as follows:

1. Physiological Sensor

2. Environmental Sensor

3. Detection and Location Tracking Sensor

Table 3: Various Type of sensors

Group	Type	Sensing Tool and Sensors
Physiological Sensors	Sensor to detecting Falls from height	Gyroscope, Accelerometer, Magnetometer
	Sensor detecting Stress	ECG
	Heat or cold and Moisture	Thermistor, Tensiometric
Environmental Sensor	Smoke and fire detection	Infrared
	Noise level	Noise sensor
Detection and Location Tracking	Proximity detection	Radar
	Location tracking	GPS, RFID

5. CONCLUSION

1. From the study conducted it can be mentioned that the IoT Based Sensors are the way to reduce the error and accident on construction industry. That can reduce and Increase the productivity.

2. From questioner survey various parameters which are important for various phase of construction are ranked as per RII Ranking.

Phase	Initiation	Planning	Execution	Closing
Cost	5	5	1	5
Schedule	6	1	2	4
Scope Creep	2	3	3	6
Conflicts	4	2	6	3
Vendor Management	1	4	5	1
Risk	3	6	4	2

3. IoT to continuously monitor safety indicators for employees in the construction industry to reduce health and safety issues.

4. Physiological monitoring, environmental sensing, proximity detection, and position tracking can all be done using wearable sensors and devices.

5. According to a recent study, it is important to coordinate the maintenance, monitoring, and inspection of workplace safety. Designing a head safety device is the goal.

6. According to the results of the questionnaire survey, the execution phase's most important variables will be cost, schedule, scope creep, and risks. Similar to what the Planning Phase will see more schedule conflicts and conflicts with other projects, the Initiation Phase will witness more difficulties with vendor management.

7. The design of IoT kit has advantages as well as limitations on the site are mentioned here with:-

   a) IR are affected by hard surface and does not function.
   b) IR radiations are harmful and can damage eyes.
   c) IR sensor can be affected by environmental conditions such as rain, fog, dust, pollution, sunlight, smoke etc.
   d) GPS does not works in confined spaces due to low GPS signals.

8. Here by it is concluded that Infrared can be replace by Temperature sensors or any other sensors while GPS can be replace by Bluetooth or Radar.

ACKNOWLEDGEMENT

Every work has an imprint of many people and it becomes the duty of author to express deep gratitude for the same. I

thank Dr. Sandip .T.Mali (HOD Civil Engineering PCCOE, Pune), Dr. Ajay.K.Gaikward (Associate Professor Civil Engineering PCCOE, Pune), Miss.Samiksha Sudhakar Shelar. (Sanjivani College of Engineering, Kopergaon)

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