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SMART HELMET FOR CONSTRUCTION WORKERS

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Abstract- ***Day by day the death rate of the construction workers at the construction site is increasing. But still there are no such remedies to reduce this fatality rate. To provide continuous monitoring of the workers and to prevent them from any health hazards during working, this system proposes a smart flexible helmet for the construction workers to provide security and rescue measures in case of any emergency conditions. The proposed system describes a smart inexpensive helmet for the construction workers made up of chromium embedded with Accelerometer and Gyroscope sensor. The helmet monitors the physical conditions of the construction workers and sends notification to the Contractor via the Bluetooth.In this project we are developing an Bluetooth product called Smart helmet, which comprises of helmet unit, Helmet unit consists of the sensors such as temperature, Heart Beat, MEMS and Ultrasonic. All the sensor values are updated in Mobile application.***

Keywords- **Accelerometer and Gyroscope**

I INTRODUCTION

The safety of employees on construction sites can be improved with the help of an innovative and highly effective solution: a smart helmet. It is a high-tech helmet that combines a number of cutting-edge technologies to give employees and supervisors real-time data and alarms, enhancing their general safety and protectivity . The smart helmet, in contrast to conventional helmets, is furnished with sensors, and other tools that let it track and detect a variety of physical and environmental factors, such as temperature, humidity, noise, and the presence of dangerous chemicals.In order to spot any signs of exhaustion or stress, it may also monitor the wearer's physiological data, such as heart rate and body temperature.Additionally, the helmet has the ability to alert managers and employees to potential dangers like falling objects or hazardous weather conditions.[1] Additionally, it can give workers immediate feedback on their posture, motions, and general performance, assisting in the reduction of accidents and injuries . Ultimately, the smart helmet is a ground-breaking and essential instrument that has the potential to significantly improve the productivity, efficiency, and safety of employees in the construction sector[2].The use of cutting-edge technologies makes it an invaluable tool in the contemporary workplace, guaranteeing that employees can carry out their duties in a secure setting[3].One sort of safety gear that incorporates cutting-edge technology to enhance worker safety on construction sites is the smart helmet for construction work. It is intended to provide in-the- moment monitoring and analysis of numerous physiological and environmental parameters, which can aid in accident prevention and enhance all-around worker safety . The smart helmet is fitted with a number of sensors that may identify a variety of dangers, including high noise levels, gas leaks, and excessive heat. Additionally, it can track a worker's vital statistics like heart rate and body temperature and provide notifications if there are any signs of stress or fatigue[4].The smart helmet has emerged as a possible solution to the construction industry's growing demand for efficiency and safety. It provides

evidence of how technology can improve worker productivity and safety in risky working conditions. The smart helmet is likely to become a crucial piece of construction businesses' safety equipment as they prioritise employee safety.IOT, Internet of Thing, is a network of thing, which may be sensors, mobile devices, physical appliances, etc. All these devices have unique identifier which enables them to collect and exchange useful data. These unique IDs are used to identify each and every worker working on the construction site.The Sensors are used to sense the activity, orientation, movement of the workers on the construction site. The death rate of the construction workers at the site has been increasing every year. If there will be working at 5th or 10th floor of the large buildings the worker may have chances to get severe heart attack, it takes some amount of time to reach that floor and recover him. Within that time, he may be expected to death. [5] In India, Approximately 38 construction workers die on constructionsiteseveryyear.Forexamplein2017,there6 7deaths,2016saw55deaths, 2015 saw 62 deaths and 2014 saw 69 deaths, etc. 67deaths,2016saw55deaths, 2015 saw 62 deaths and 2014 saw 69 deaths, etc.

II RELEVANT STUDIES

M. Anne Sanchana et al (2023) demonstrated Motorcycle accidents are a significant public concern worldwide. Accidents have been increasing rapidly which leads to the loss of several lives. One of the main contributing factors to the severity of injuries in these accidents is the lack of helmet use. Though the usage of helmets is necessary, it is also considered a piece of mandatory safety equipment among drivers, but they do not make use of it which causes unfortunate incidents to take place. Traffic police do try to bring awareness among the people but most of the population refuses to follow them. To avoid such incidents and to detect people from breaking the rules, this research was introduced[18].

K. Patel et al (2023) proposed Ensuring safety in the workplace is crucial to the wellbeing of workers and the success of organizations. One essential aspect of workplace safety is the use of safety helmets in hazardous environments. Safety helmets protect workers from head injuries caused by falling objects, electric shocks, and other hazards. In recent years, computer vision-based safety helmet detection systems have gained popularity as a means of ensuring compliance with safety regulations and reducing accidents. This study proposes a safety helmet detection system based on the You Only Look Once (YOLO) V8 algorithm, which is a state-of-the-art object detection algorithm that has shown superior performance in detecting small objects in real-time. The proposed system involves training the YOLO V8 algorithm on a dataset of images containing workers with and without safety helmets. The dataset was carefully curated to include various lighting conditions, camera angles, and helmet types. The trained model was then evaluated on a separate test set to measure its performance. Experimental results demonstrate that the proposed approach achieves high accuracy in detecting safety helmets, with an average precision of 0.99 and a recall of 0.99[19].

H. Lin et al (2021) utilized Recent advances in the automated detection of motorcycle riders' helmet use have enabled road safety actors to process large scale video data efficiently and with high accuracy. To distinguish drivers from passengers in helmet use, the most straightforward way is to train a multi-class classifier, where each class corresponds to a specific combination of rider position and individual riders' helmet use. However, such strategy results in long-tailed data distribution, with critically low class samples for a number of uncommon classes. In this paper, we propose a novel approach to address this limitation. Let n be the maximum number of riders a motorcycle can hold, we encode the helmet use on a motorcycle as a vector with 2n bits, where the first n bits denote if the encoded positions have riders, and the latter n bits denote if the rider in the corresponding position wears a helmet. With the novel helmet use positional encoding, we propose a deep learning model that stands on existing image classification architecture[20].

J. A. B. Susa et al (2022) analysed In recent years, riding a motorcycle has become one of the most convenient ways for consumers to go to their destination. Helmets are very important and necessary for the safety of motorcyclists, however, officers find it difficult to enforce the laws regarding the wearing of authorized helmets. This system was established to determine whether or not a helmet is allowed. The authorized helmet for riders is the full-face helmet. This vision-based system could aid in identifying riders who are wearing helmets that aren't fitting properly. The system used the YOLOv3 model and a deep learning approach to use the helmet detection model in this work. As a result, the model with the best training received an mAP of 97%. This proposed device may be used on busy routes to monitor motorcyclists to see if they are wearing an authorized helmet[21].

P. C, R. C, P. N. M, R. P. S and S. M et al (2022) analyzed Nowadays, in most countries, citizens are forced to wear helmets while biking, and it is suggested not to consume alcohol. It is illegal to drink alcohol while riding a bike. But even now, these rules are disobeyed in most of the countries. To overcome this issue, a smart helmet with vehicle theft detection has been developed to address this issue. Helmet unit and vehicle unit is developed. Helmet unit confirms the safety of the rider and vehicle unit confirms the vehicle location and controls the engine part of the bike. Load cell sensor is placed in the vehicle unit to measure the load on the bike[22].

Somantri et al (2022) introduced The rise of cases of theft and robbery of motorcycles requires vehicle owners to increase vigilance. Various ways have been done to prevent the theft and robbery of motorbikes, for example, by using a lot of locks and alarms. Unfortunately, some of these methods cannot overcome the rampant motorcycle theft today. In addition, the awareness of motorcyclists on the use of

helmets is currently very minimal, so if a motorcyclist gets into a serious accindent without wearing a helmet, it can be fatal. This paper aims to design and manufacture a helmet prototype for safety riders and anticipate current conditions. This smart helmet is integrated with the motorcycle engine. The motorcycle engine will not turn off if it is far from the smart helmet, and this smart helmet will report the incident and detect the location of the incident to none of the registered cellphones. In addition, this helmet can also ensure that the rider cannot operate his motorbike without using it. This Smart Helmet is designed based on IoT using a wireless module to connect to the motorcycle engine, a GSM module for an alarm and notification system, and a GPS module to unify events with latitude and longitude coordinates. Smart helmets have been successfully integrated with motorcycle electricity [23].

S. Johnpaul et al (2022) presented The smart helmet's purpose is to provide features for detecting and reporting whether a person has drunk alcohol while wearing a helmet. Because riders don't wear helmets and drink alcohol, road accidents are on the rise. Thousands of people die every year in vehicle accidents in today's world. Accidents can often be reduced by using a smart helmet. The project's main goal is to build a practical helmet that can prevent accidents without the use of a helmet and detect alcohol. The touch sensor identifies whether the user is wearing a helmet. The Gas sensor detects the presence of alcohol in the rider's breath. The bike will not start if the rider is not wearing a helmet or has consumed alcohol. The bike can only be started if there are no signs of intoxication and a helmet is worn. Sensor operations are used to construct the system[24].

D. N., A. P. et al (2019) presented In this paper, we have reviewed the recent trends in developing Smart Helmet system. The smart helmet system is used to prevent the accidents in motor bikes and to identify the bike accidents on time for wellness of human being. Also, the smart helmet system analyzed in this paper is used in mining industry for safeguarding the miners from hazardous events in the mine and to alert the miners from hazardous gas emissions inside it. The research also helps to understand the smart helmet system evolved over the period and currently by using emerging technology like Internet of Things (IoT). This work also addresses the intelligent motor bike helmet system which is used to inform the rider about rear big trucks/buses for avoiding collisions They use a memory cell and gates to control the flow of information, allowing them to selectively retain or discard information as needed and thus avoid the vanishing gradient problem that plagues traditional RNNs. LSTMs are widely used[25].

III SYSTEM DESIGN

A. PROPOSED METHODOLY

The smart helmet is embedded with Arduino Uno kit to which the sensors like Temperature, Heartbeat sensor, Accelerometer and ultrasonic are connected. The helmet is also provided with a sensor kit to monitor others in case of any disaster. All these smart helmets are worn by the construction workers at the time of working.The civil engineer or the contractor receives all the information about the worker provided by the helmet with the use of the Bluetooth module involved in it. The contractor or the civil engineer monitors functions of all the workers provided by the helmet with the use of a mobile application specially designed to serve this purpose

B.HARDWARE

Arduino Microcontroller:

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter."Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

Figure 1.1: BLOCK DIAGRAM

MEMS Sensor:

We are using MEMS SENSOR (MMA7600FC) is used for fall detection. This may arise due to low or high Blood Pressure (BP).With the help of this MMA7600FC, whether fall detection occurred or not is known. Micro electro mechanical systems (MEMS, also written as microelectromechanical, Micro Electro Mechanical or microelectronic and micro electro mechanical systems and the related micro mechatronics) are the technology of microscopic devices, particularly those with moving parts. MEMS are also referred as micro machines in Japan, or micro systems technology (MST) in Europe. MEMS are made up of components between 1 and 100 micro meters in size (i.e., 0.001 to 0.1 mm), and MEMS devices generally range in size from 20 micro meters to a millimeter (i.e., 0.02 to 1.0 mm), although

components arranged in arrays (e.g., digital micro mirror devices) can be more than 1000 mm2 . They usually consist of a central unit that processes data (the microprocessor) and several components that interact with the surroundings such as micro sensors. Because of the large surface area, forces produced by ambient electromagnetism (e.g., electrostatic charges and magnetic moments), and fluid dynamics (e.g., surface tension and viscosity) are more important design considerations than with larger scale mechanical devices.

HEART BEAT SENSOR:

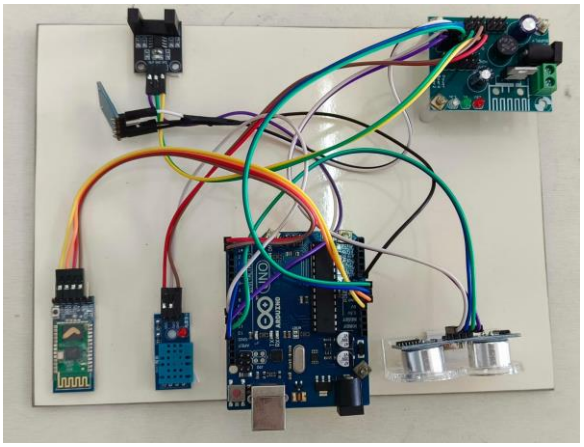
Heartbeat Sensor is an electronic device that is used to measure the heart rate i.e. speed of the heartbeat. Monitoring body temperature, heart rate and blood pressure are the basic things that we do in order to keep us healthy.Heart Rate can be monitored in two ways: one way is to manually check the pulse either at wrists or neck and the other way is to use a Heartbeat Sensor.

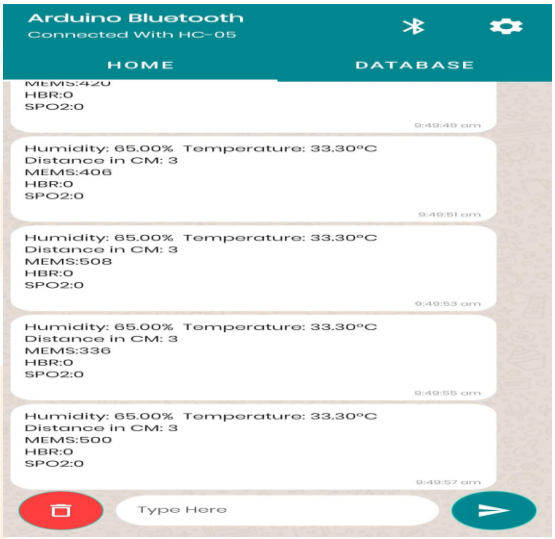
ULTRASONIC SENSOR:

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).In order to calculate the distance between the sensor and the object, the sensor measures the time it takes between the emission of the sound by the transmitter to its contact with the receiver. The formula for this calculation is D = ½ T x C (where D is the distance, T is the time, and C is the speed of sound ~ 343 meters/second).

IV. EXPERIMENTAL RESULTS

Through this smart helmet, the constructor can continuously monitor the entire works involved in construction process and can also get notifications about workers physical condition by using it he can immediately save the workers from serious conditions in case of emergency. By using of Arduino Bluetooth application the constructor can able to get above data from workers.





Here there are room temperature values and body temperature of worker and heart beat values and spo2 level and distance of object from worker. By using of this we can predict the cause of death and we can able to stop the death.

V. CONCLUSION

There are different mishap ID cases. In our work, the exactness is high, which shows that our proposed framework is precise in observing calamities by utilizing the vibration, temperature, fall detection.If this proposed system is implemented to ensure the complete safety of the workers at the construction site. Through this smart helmet, the contractor can continuously monitor the entire workers involved in construction process and can also get notification about the workers' physical condition and can immediately save the workers from any serious issues in case of emergency. Hence we can reduce the death rate of the construction workers and provides increased security to them.

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