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SMART HELMET USING RADIO FREQUENCY IDENTIFICATION TECHNOLOGY

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Abstract

2-wheeler road accidents are increasing as every year; around 50,000 people lose their lives in the fatal road accidents. This project focuses on the safety of 2-wheeler riders, through locking the engine when the driver is not wearing the helmet using the Radio Frequency technology. The studies have shown the severity of injuries is highly reduced when the driver is wearing the helmet. This project will help the government with its initiative towards road safety and a safer society for everyone. The government surveys conducted by the ministry of transport say, 1214 road crashes occur every day in India among which two-wheelers account for 25% of total road crash deaths. The smart helmet uses Radio Frequency Identification technology, to ensure that the driver is wearing the helmet. In case the driver is not wearing the helmet the R.F transmitter installed in the Smart Helmet will not send the signal to the R.F receiver installed in the vehicle, and thus the vehicle will not start. The R.F technology is cheap and inexpensive and easy to install in the 2 wheelers and helmets which makes our project economical and cost-efficient. Including the radio frequency transmitter and receiver can be done cost-efficiently and doesn't raise the cost of helmets with any significant margin.

Keywords: Radio Frequency Identification, Smart Helmet

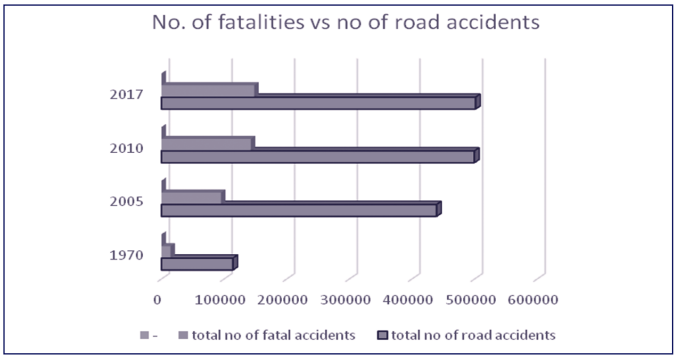
1. INTRODUCTION

Helmet is an essential safety wear during riding 2-wheelers on road. National crime records bureau (NCRB) reports in 2016 that 464,674 road accidents have occurred which results in 148,707 traffic related deaths in India [1]. Majority of accidents are caused due to driver's fault including over speeding, driving under influence and hit and run cases. Road accidents not only harm the driver but also other pedestrians. According to the global survey done by WHO (World Health Organization) [2], India suffered a road fatality rate of 16.6 per 1, 00,000 people in 2013 and collision fatality rate of 17.4 deaths per 1, 00,000 people. This is less than low-income countries at 24.1 deaths and higher than high income countries at 9.2 deaths per 1, 00,000 people. The study done according to the World Health Organization, 1.25 million people die each year as a result of road traffic crashes [3]. Table 1 show rates of involvement in all police reported crashes, injury crashes and fatal crashes per 100 million miles driven with relation to driver's age in United States, 2014-2015. Road traffic injuries are the first cause of death among people aged between 15 and 29 years. Almost half of those dying on the world's roads are "vulnerable road users": pedestrians, cyclists, and motorcyclists.

Table 1.Number fatal crashes per year in India (Source: www.aaafoundation.org)

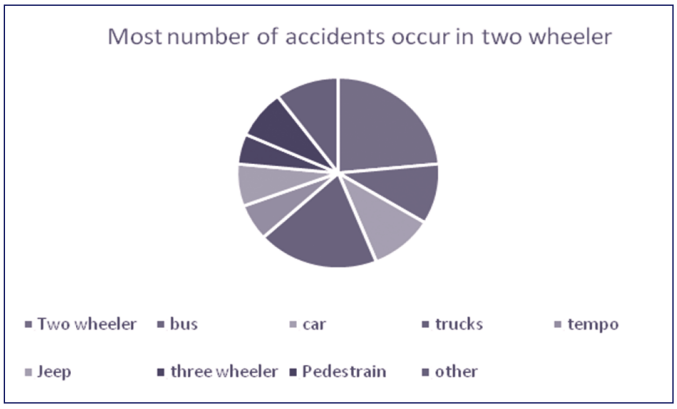
Rate per 100 million miles driven			
Age of Driver	All crashes	Injury crashes	Fatal crashes
16-17	1432	361	3.75
18-19	730	197	2.47
20-24	572	157	2.15
25-29	526	150	1.99
30-39	328	92	1.20
40-49	314	90	1.12
50-59	315	88	1.25
60-69	241	67	1.04
70-79	301	86	1.79
80+	432	131	3.85

Fig .1 Year wise fatal injury (Source: www.wricitieshub.org)



In fig. 1, the graph relates increasing number of accidents with each year. It reflects the increasing number of accidents, indicating the increase in number of the fatalities occurred during the road accidents. With the 2-wheeler sales on rise, India is the second largest producer of two-wheelers in the world. It stands next only to China in terms of the number of two-wheelers produced [4]. The fig. 2 shows the majority of accidents in case of two-wheelers. Out of 1.25 million fatalities, 50,000 deaths occur in two-wheeler accidents. This significantly reduces the probability of seriously injured or fatalities by 8.7 percentage. Reduction in accidents goes hand in hand with an increase in the percentage of slightly injured, while the percentage of unharmed and the total number of two wheeler accidents did not change.

Fig.2 Percentage distribution of according to type of vehicle (Source: www.wricitieshub.org)



Following section shows the literature published on the road accidents, safety due to use of helmet and design of helmet.

2. LITERATURE SURVEY

Mishra and Banerji 1984 [5] published their research on analysis head injuries sustained in a 2 wheeler accidents. They observed 12,000 MTW accidents victims among which 107 were fatalities. They considered a number of parameters to investigate that were worn during the accidents and concluded that only 20% of MTW drivers are adequately protected. They found out that full face helmets provide more safety to the rider in comparison to jet type helmet.

Newman 1998 [6] published an in depth analysis of the data on road accidents. He observed that out of total number of accidents, male drivers were included in 80% of accidents. With age group of 18-20 males were part of 43% of accidents. He concluded that 52% of all cases of accidents were caused due to inattention on the part of automobile operator and careless driving. In order to prevent road accidents, more effective motor cycle training programs and more affective helmets are suggested.

Blostein et al. 2015 [7] presented the design of a prototype helmet fitting recommendation system using shape-based helmet fitting. The shape based helmet fitting system uses a Kinect sensor to scan a client's head and then compares the head shape to helmet shapes from a database of off-the-shelf helmets. The helmet that is too tight or too loose would be inherently a bad fit. The tighter the fit, the more force is transmitted to the skull and brain. However, a helmet that is too loose may obscure vision and result in other injuries, or be displaced during a crash.

Kodam 2015 [8] used micro controller to identity whether the driver is wearing a helmet or not. In case of accidents, GPS module locates the location of accident and GSM module installed in the helmet will send the driver's location details to the registered mobile numbers via Sms, including details of scope and longitude value. AT89S52 Cmos 8-bit microcontroller is use to process the information relayed by the liquor sensor and limit switches.

Kanodia et al. 2016 [9] designed a helmet to make helmets mandatory. A MQ5 liquor sensor along with GSM module is also installed in the helmet to identify if the driver is drunk and in case of accident report to the emergency control room so an ambulance can be dispatched. By implementing this electronic helmet system, a safer and much more secure two wheeler journey will be possible.

Sandeepa et al. 2016 [10] developed a smart helmet, which automatically checks whether the person is wearing the helmet and has non-alcoholic breath while driving. There they used a transmitter at the helmet and the receiver at the bike. There is a switch which is used to ensure the wearing of helmet on the head. An alcohol sensor is placed near to the mouth of the driver in the helmet to detect the presence of alcohol. The data to be transferred is coded with RF encoder and transmitted through radio frequency transmitter.

Sachin et al. 2017 [11] proposed a system using Arduino Uno as a microcontroller which ensured the proper wearing of helmet, alcohol free riding and also the safe and quick information to the emergency contacts. Engine is found to remain off if the conditions of safe riding are not fulfilled. For the alcohol detection, use of breath analyzer was made which ensured the limit of alcohol content is below the permissible limit and rider is safe to drive or not.

Wankhede and Jadhav 2017 [12] implemented the IR sensors and limit switches to identify if the driver is wearing helmet. With further installing GPS and GSM modules to identify the location after an accident occurs. The production of two wheelers has increased by five-fold in last decade. The industry is still growing rapidly with growth rate of 7-10% each year. With this rapid growth the data has shown the number of vehicles and the number of accidents occurring has increased significantly. Previous strives have been made to make the roads of India safer by imposing traffic rules strictly in a number of states.

Patel et al. [13] designed a smart helmet which aimed at providing safety to the bike rider. With the help of proper switch mounted in helmet, the two-wheeler will not start without wearing helmet so that the safety of rider is assured. In case an accident occurs, their system will provide information to the ambulance about the accident, so that emergency actions can be taken as soon as possible to save the life of the person who met with an accident.

Sahil et al. 2018 [14] designed a helmet for mine workers that can measure the data of the surrounding air and using Zigbee Wireless Technology and relay it back to the computer to keep monitoring on the conditions inside the mines. This continuous monitoring inside the mines aids in maintaining proper working conditions for the mine workers and in emergency will help in quick evacuation. For the purpose of monitoring the harmful content of gases in the atmosphere, they used MQ-4 Gas Sensor which proves to be highly sensitive for the detection of Methane, Propane and Butane gases and also detect different combustible gases.

Vinod and Krishna 2018 [15], proposed that in case of accident the stress limit will exceed and the location of the driver will be reported to the family members automatically by GSM module. The impact when a motorcyclist involves in a high-speed accident without wearing a helmet is very dangerous and can cause fatality. The impact when a motorcyclist involves in a high-speed accident without wearing a helmet is very dangerous and can cause fatality. The impact when a motorcyclist involves in a high-speed accident without wearing a helmet is very dangerous and can cause fatality. The impact when a motorcyclist involves in a high-speed accident without wearing a helmet is very dangerous and can cause fatality.

The goal of this literature survey is to review the previously published research papers on smart helmets integrated with technologies to prevent or minimize the injuries sustained in the road accidents. Based on above data, it is found that people should be aware of road safety measures as well as importance of wearing helmet during riding of 2-wheeler. Wearing helmet can reduce the probability of deaths due to road accidents. Therefore, this study focuses on developing a system which ensure the driver's safety and making wearing helmets mandatory. Hence following are the objectives of present work:

1. Implementing Radio frequency identification technology (RFID) in helmet with a transmitter is installed in the helmet with limit switches and receiver is installed in the engine of the bike. In case the driver is not wearing helmet, the bike engine will not start.
2. This method will aid to road safety regulation law with negligible increase in helmet cost.
3. This study can be further improved upon by installing a GSM and GPS module to identify the location of the accident and send the coordinates of accident location to emergency services and to the registered mobile numbers.

3. METHODOLOGY

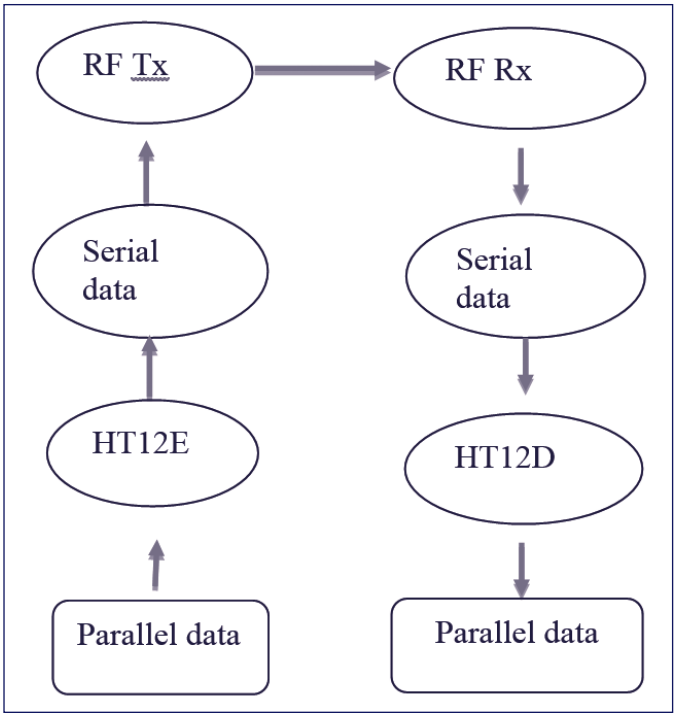
A. Radio Frequency Identification (RFID):

The helmet in this study works on the Radio Frequency Identification Technology. The objects are assigned with a tag used to identify and track. Each tag is unique in nature, with electronically stored information. RFID (Radio Frequency Identification) is installed in automobiles to track the progress of the vehicle on the assembly line. Move over they are also implanted in the live stocks to track or identify them easily. The RFID chips have high accessibility which makes them economical. With the high production of the silicon chips they are becoming more and more inexpensive with the time. RFID system uses tags, to identify the object. Two-way radio transmitter-receivers are called interrogators or readers which send a signal to the tag and read its response immediately.

B. RF Remote Control Circuit Principles:

When we press any key in the remote, the transmitter section generates the corresponding RF signal and this signal is received by the receiver section and switches the corresponding appliance. A four-channel encoder/decoder pair is used in this system. The input signals at the transmitter section are taken from the four switches and the output signals at the receiver are indicated by the four LED's corresponding to each switch. From the fig. 3 diagram, it is very easy to understand the working of the circuit. Parallel data refers to the inputs given by the user simultaneously. Input data for HT12E (I.C) can vary from 1-4. Once the Parallel Data (input) is given, it is carried forward to HT12E, which converts the input data into 12bit serial data and it is transmitted using Radio Frequency up to the receiver. It is also therefore called Encoder IC (which emits the RF into space).

Fig. 3 Block diagram of working of smart helmet
Source: www.electronicshub.com



Once the transmitted serial data is received by RF Receiver, it is then converted back to its original form from 12-bit data and is supplied to Parallel Data which then refers to the final output. It is therefore called Decoder IC (which detects the RF from space).

Working: Parallel Data - It is the input received from the pressing limit switches placed inside the helmet. When the driver wears the helmet the limit switches are pressed which in turn completes the circuit.

Transmitter Encoder - It encodes the parallel data or output from the limit switches into serial language for the transmitter to understand.

Serial language - It consists of the instructions and values necessary for the forming and transmitting of signals.

RF transmitter - The transmitter transmits the data in form of signal, which can be captured by a receiver.

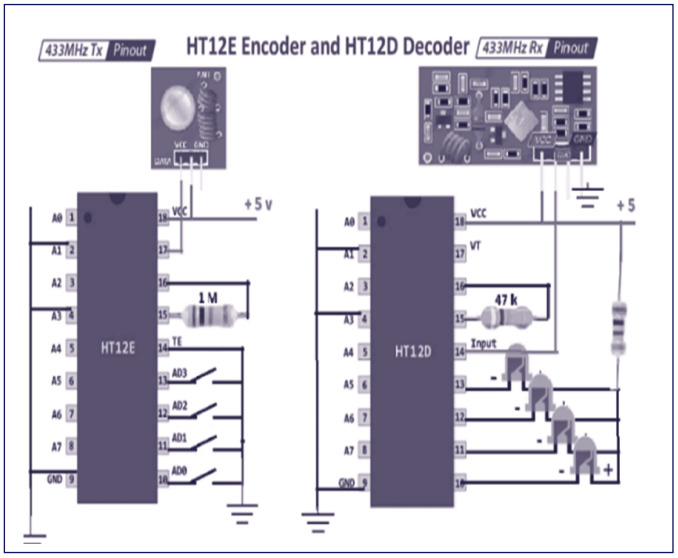
Receiver Encoder - It encodes the data in serial language for the interpreter to understand.

Serial Language - It has the instructions of the type of signal to be emitted from the transmitter.

RF Receiver - The received signal is converted in form of serial language which is decoded by the decoder and finally converted into parallel data.

Fig. 4 Circuit diagram of transmitter and receiver of RFID

Source: (https://www.instructables.com/id/Make-a-RF-Transmitter-and-Receiver-With-HT12E-HT12/)

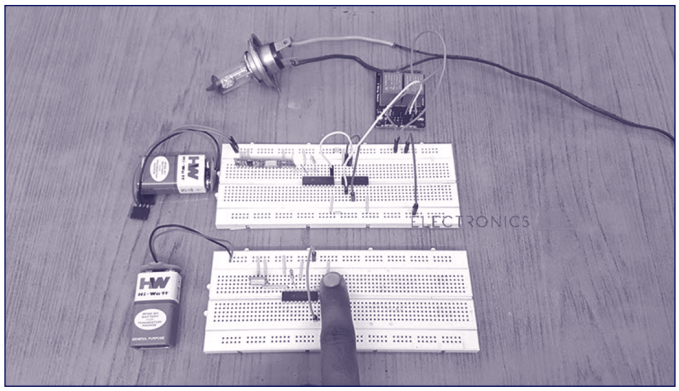


In fig 4, shows HT12E and HT12D encoder and decoder IC along with their junctions. The circuit shown at the left side is the transmitting circuit whereas the one at the right is the receiving circuit. AD0, AD1, AD2, AD3 in the transmitting circuit are the parallel inputs data which can be given whereas 10,11,12,13 in the receiving circuit are the corresponding parallel output data.

Circuit Components:

- HT12E encoder IC,
- HT12D decoder IC,
- RF 433 MHz transmitter and receiver,
- Resistors – 33KΩ, 750KΩ, 1KΩ,
- Relay Module,
- Lamp,
- Connecting Wires,
- Breadboards.

Fig. 5 Actual circuit of transmitter and receiver of smart helmet



The fig 5 shows the complete circuit of transmitter and receiver after the installation of components.

RF Modules (433MHz):

This module operates at radio frequency. The Radio Frequency range is 30 KHz to 300 GHz. In this system, RF modules use ASK (Amplitude Shift Keying) modulation. Transmission through RF is better than IR because, the RF signal can travel for longer distances as compare to infrared. And IR mostly supports line-of-sight mode, RF signals can travel even if there is an obstruction. RF transmission is more reliable and stronger as compared to IR. The chosen pair of RF transmitter and receiver should have same frequency. The transmission speed of these modules is 1Kbps to 10Kbps.

Operating a Remote-control Circuit:

1. Connect the circuit as shown in the figure 5.
2. Apply 9V supply to the transmitter and receiver sections.
3. Press the button at transmitter section; you can observe that the Lamp connected to the relay at the receiver section will turn ON.
4. Now disconnect the power supply from transmitter and receiver sections.

Fig. 6 shows the actual smart helmet.

The fig. 6 shows the Smart Helmet, the device visible at the top of helmet is RFID transmitter. A Limit Switch is installed in the Helmet, which is not visible in this fig.

4. CONCLUSION

In the present work, smart helmet is successfully modified in existing helmet using RFID technology. Circuit of transmitter and receiver is built to connect helmet and engine. This study is helpful to make helmets mandatory for the rider, to use as a protective guard in order to drive a two-wheeler and ensures the safety. It reduces the risks of brain injuries and deaths in case of an accident. The study can be easily integrated in the mass production assemblies as it has a very simple design and also less expensive. The investment made in this study, will reduce the road accidents in India.

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