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Bikers Protection through Smart Helmet and Stunt Detection

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ABSTRACT- *Brain injuries from bike accidents are the leading causes of permanent disability and sometimes even sudden deaths. Despite existing rules making use of safety helmets mandatory at the time of bike riding, most riders do not use them. Also, the delay in shifting an injured person to the hospital after an accident increases the chances of adverse outcome. Deaths due to stunt biking have also increased drastically. This motivates us to create a system which can enhance the safety of bikers, by ensuring the use of helmet. We intend putting together a safety system that when installed on a motorcycle makes certain that the engine ignition occurs only after the rider is wearing a helmet. And also in case the rider crashes, a message with the location of the rider is sent to a nearby hospital and also the family members of the rider. We also intend to detect various stunts performed by the biker and notify the nearby police station using a tilt sensor, GPS and GSM.*

Key Words: Arduino, NRF, GSM, GPS

1. INTRODUCTION

According to WHO report, by the year 2020, the major killer in India will be road accidents; in fact, the accident rate in India (35 per 1000 vehicles) is one of the highest in the world. Motorbike accidents constitute significant proportion of vehicular accidents. Injuries from bike accidents are the leading causes of permanent disability and sometimes even sudden deaths. The majority of these accidents occur due to over speeding and stunts. The inability of bikers in wearing helmets increases the damage. Use of helmets bring down the severity of brain injury, skull fractures and neurological disabilities after an accident. Despite existing rules making use of safety helmets mandatory at the time of bike riding, most riders violate these rules. Also, the delay in shifting an injured person to the hospital after an accident increases the chances of adverse outcome. We propose to develop a system that makes it necessary for the biker to wear the helmet and in case of accidents notify nearby hospital and relatives as soon as possible. We also propose to detect various stunts performed by the biker and notify a nearby police station

2. METHODOLGY

Our system can be divided into two modules; the helmet side and the bike side. In the helmet side we design a sensor which will detect human head presence. The sensor detects the presence of human head and communicates it to the microcontroller. The microcontroller (Arduino) sends this information to the engine using NRF (NORDIC RADIO FREQUENCY). The NRF on the transmitter side receives this message and transfers it to microcontroller which further controls the ignition. We also place an accelerometer in the helmet which detects the degree of tilt so that if the rider crashes, the sensors perceive it and the Arduino extracts GPS data using the GPS module that is interfaced with Arduino. When the tilt exceeds maximum tilt limit, the GSM module automatically sends message to ambulance/hospital, police and family members. In addition to above we also detect the stunts performed by the biker for that we equip the motorbike with tilt sensors. These tilt sensors have a threshold for inclination whenever the biker exceeds that threshold the stunt has been performed, the Arduino processes that input and sends the location and the registration number of the bike to the nearby police station. Figure 1 shows the Block Diagram Helmet side and Figure 2 shows Block Diagram Bike Side.

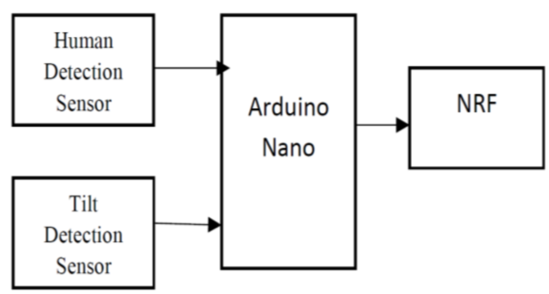

Figure 1. Block Diagram Helmet side

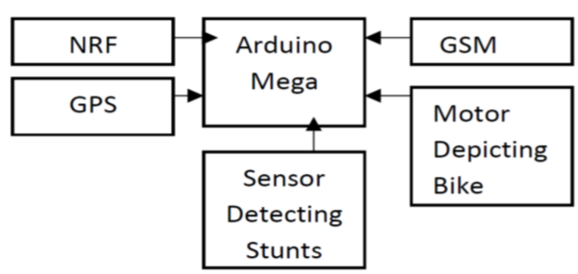

Figure 2. Block Diagram Bike Side

3. HARDWARE REQUIREMENTS

Proposed project consists of following parts:

- Helmet side
- Bike side

3.1. Helmet Side

- Arduino Nano
- NRF
- Skin detection sensor
- Accelerometer

3.2. Bike Side

- Arduino Mega
- NRF
- GPS
- GSM
- Accelerometer
- L293D

C1. ARDUINO

Arduino refers to an open source electronic Platform or board which is designed to make electronics more easily accessible. It can be purchased, preassembled or because the hardware design is open source, built by hand. An Arduino board generally consists of an Atmel 8,16or32bit AVR microcontroller (although since 2015 other makers' microcontrollers have been used) with complementary components that facilitate programming and incorporation in to other circuits. Two microcontroller boards were taken as per requirement for the project:

C1.1 Arduino Mega:

It consists At-mega AVR 2560 R3 microcontroller. It has 54 digital Output /Input pins (of which 15 pins can be used as PWM signals), 16 analog input s, 4 UART (hardware serial port), a 16MHz oscillator. Opening voltage of the microcontroller is 5V.

C1.2 Arduino Nano:

The Arduino Nano is a small, complete, and Bread board friendly boar d based on the ATmega328 (Arduino Nano 3. x) or ATmega168 (ArduinoNano2. x). It has more or less the same functionality of the Arduino Mega, but in a different package. It Lacks only a DC power jack, and works with a Mini B USB cable instead of a standard one. It has14digital Output / Input pins (of which 6pins can be used a PWM signals), 8 analog Inputs.

C2. GLOBAL POSITIONING SYSTEM

The Global Positioning System (GPS) is a space-based navigations system that provides location and time information in all weather conditions, anywhere on or near the earth where there is an unobstructed line of sight to four or more GPS satellites. What is a GPS? The Global Positioning System (GPS) tells you where you are on Earth. The GPS system provides critical capabilities to military, civil and commercial users around the world. The GPS technology has tremendous amount of applications in GIS & Remote Sensing data collection, surveying and mapping. The technology seems to be beneficiary to the GPS user community in terms of obtaining accurate data up to about 100 m for navigation, meter-level for mapping and down to millimeter level for geodetic positing. In simple words it can be said that if one has a small GPS receiver, he can get his position anywhere in the land, sea, air, desert or forest in terms of any co-ordinate system. Development of GPS.

GPS project was developed in 1973, to overcome the limitations of previous navigation systems, integrating ideas from several predecessors, including a number of classified engineering design studies from the 1960s. The current system became operational on June 26, 1993 when the 24th satellite was launched. Bradford Parkinson, Roger L. Easton, and Ivan A. Getting are credited for inventing the GPS.

C3. GLOBAL SYSYTEM FOR MOBILE COMMUNICATION

GSM (Global System for Mobile Communications) is a second-generation digital mobile telephone standard using a variation of Time Division Multiple Access (TDMA). It is the most widely used of the three digital wireless telephone technologies - CDMA (Code Division Multiple Access), GSM and TDMA. GSM digitizes and compresses voice data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900, 1800 or 1,900MHz frequency bands.

GSM was initially developed as a pan-European collaboration, intended to enable mobile roaming between member countries. As at March 2003, GSM digital wireless services were offered in some form in over 193 countries. In June 2002, about 69% of all digital mobile subscriptions in the world used GSM phones on GSM networks.

The GSM network can be divided into three broad parts the subscriber, carrier and the mobile station

The base station subsystem controls the radio link with the mobile station

The network subsystem performs the switching of calls between the mobile users and other mobile and fixed network users

C3.1 Mobile Station

The mobile station consists of the mobile equipment, i.e. the handset, and a smart card called the Subscriber Identity Module (SIM). The SIM provides personal mobility, so that the user can have access to subscribed services irrespective of a specific terminal. By inserting the SIM card into another GSM terminal, the user is able to receive and make calls from that terminal, and receive other subscribed services.

The mobile equipment is uniquely identified by the International Mobile Equipment Identity (IMEI). The SIM card contains the International Mobile Subscriber Identity (IMSI) used to identify the subscriber to the system, a secret key for authentication and other information. The IMEI and the IMSI are independent, thereby allowing personal mobility. The SIM card may be protected against unauthorized use by a password or personal identity number.

C3.2 Base Station Subsystem

The base station subsystem is composed of two parts, the base transceiver station and the base station controller. These communicate across a standardized "Abis" interface, allowing operation between components made by different suppliers.

The base transceiver station houses the radio transceivers that define a cell and handles the radio-link protocols with the mobile station. In a large urban area, there will potentially be a large number of base transceiver stations deployed, thus the requirements for a base transceiver station are ruggedness, reliability, portability and minimum cost. The base station controller manages the radio resources for one or more base transceiver stations. It is the connection between the mobile station and the mobile services switching center.

C3.3 Network Substation

The central component of the network subsystem is the mobile services switching center. This acts like a normal switching node of the PSTN (Public Switched Telephone Network) or ISDN (Integrated Services Digital Network) and connects the mobile signal to these fixed networks. It additionally provides all the functionality needed to handle a mobile subscriber, such as registration, authentication, location updating, and handovers and call routing to a roaming subscriber.

C3.4 Radio Spectrum

Since radio spectrum is a limited resource shared by all users, a method must be devised to divide up the bandwidth among as many users as possible. The method chosen by GSM is a combination of Time and Frequency Division Multiple Access (TDMA/FDMA). The FDMA part involves the division by frequency of the (maximum) 25MHz bandwidth into 124 carrier frequencies spaced 200 kHz apart. One or more carrier frequencies are assigned to each base station.

Each of these carrier frequencies is then divided in time, using a TDMA scheme. The fundamental unit of time in this TDMA scheme is called a burst period and it lasts 15/26 milliseconds (ms) (or approximately 0.577ms). Eight burst periods are grouped into a TDMA frame (120/26ms, or approximately 4.615ms), which forms the basic unit for the definition of logical channels. One physical channel is one burst period per TDMA frame.

Channels are defined by the number and position of their corresponding burst periods. All these definitions are cyclical, and the entire pattern repeats approximately every three hours. Channels can be divided into dedicated channels, which are allocated to a mobile station, and common channels, which are used by mobile stations in idle mode.

C3.5 Speech Coding

GSM is a digital system, so speech, which is inherently analog, has to be digitized. The GSM group studied several speech coding algorithms on the basis of subjective speech quality and complexity (which is related to cost, processing delay and power consumption once implemented) before arriving at the choice of a Regular Pulse Excited - Linear Predictive Coder (RPE-LPC) with a long term predictor loop. Basically, information from previous samples, which does not change very quickly, is used to predict the current sample. The coefficients of the linear combination of the previous samples, plus an encoded form of the residual, the difference between the predicted and actual sample, represent the signal. Speech is divided into 20 (ms) samples, each of which is encoded as 260 bits, giving a total bit rate of 13kbps (kilobits per second). This is the so-called full-rate speech coding. Recently, an enhanced full-rate (EFR) speech coding algorithm has been implemented by some North American GSM1900 operators. This is said to provide improved speech quality using the existing 13kbps bit rate.

C4. ACCELEROMETER

An **accelerometer** is a device that measures the vibration, or acceleration of motion of a structure. The force caused by vibration or a change in motion (acceleration) causes the mass to "squeeze" the piezoelectric material which produces an electrical charge that is proportional to the force exerted upon it. Since the charge is proportional to the force, and the mass is a constant, then the charge is also proportional to the acceleration.

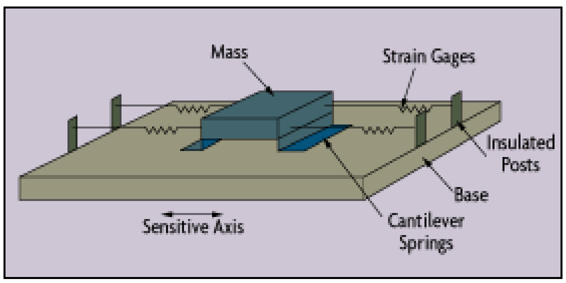

Figure 3. PIEZOELECTRIC FORCE SENSOR

C4.1 Accelerometers Types

There are two types of piezoelectric accelerometers (vibration sensors). The first type is a "high impedance" charge output accelerometer. In this type of accelerometer the piezoelectric crystal produces an electrical charge which is connected directly to the measurement instruments. The charge output requires special accommodations and instrumentation most commonly found in research facilities. This type of accelerometer is also used in high temperature applications (>120C) where low impedance models cannot be used.

The second type of accelerometer is a low impedance output accelerometer. A low impedance accelerometer has a charge accelerometer as its front end but has a tiny built-in micro-circuit and FET transistor that converts that charge into a low impedance voltage that can easily interface with standard instrumentation. This type of accelerometer is commonly used in industry. An accelerometer power supply like the ACC- PS1, provides the proper power to the microcircuit 18 to 24 V @ 2 mA constant current and removes the DC bias level, they typically produces a zero based output signal up to +/- 5V depending upon the mV/g rating of the accelerometer. All OMEGA(R) accelerometers are this low impedance type.

4. SOFTWARE REQUIREMENT

Arduino programs may be written in any programming language with a compiler that produces binary machine code. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio. The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in Java. It originated from the IDE for the Processing programming language project and the Wiring project. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and provides simple one-click mechanism for compiling and loading programs to an Arduino board. A program written with the IDE for Arduino is called a "sketch".

The Arduino IDE supports the C and C++ programming languages using special rules of code organization. The Arduino IDE supplies a software library called "Wiring" from the Wiring project, which provides many common input and output procedures. A typical Arduino C/C++ sketch consists of two functions that are compiled and linked with a program stub main () into an executable cyclic program:

- setup (): a function that runs once at the start of a program and that can initialize settings.
- loop (): a function called repeatedly until the board powers off.

After compilation and linking with the GNU tool chain, also included with the IDE distribution, the Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal coding that is loaded into the Arduino board by a loader program in the board's firmware.

5. CONCLUSION

The results of this project have proved that the motorcycle's engine will only start when the helmet is worn. It makes one's bike secure at crucial times especially when one is away from bike and someone is trying to steal it.

6. FUTURE WORK

Apart from RF. Module another type of wireless communication can be achieved. Besides, we can add a buzzer in the helmet and when the speed exceeds some limit the buzzer starts ringing and hence the motorcyclist will be more alert and will slow down the motorcycle once they receive the signal.

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