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Hardware Design For Detecting Electromagnetic Wave Exposure To Human Body

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Abstract. Electromagnetic wave propagation of personal communication devices at home has been a source of concern at the current research. In particular, there are a considerable number of peer-reviewed publications which show that mobile phone and Wi-Fi exposed a body affects and case some chronic problems to the human body. The main objective of this project is to design and analyze the effect of electromagnetic exposure on human body based on the trigger rate of 100 via automatic device assessment and warning strategy. The result shows that, a significant value of the electromagnetic wave exposure based on the success rate of 72% throughout 25 trial times of test. However, the system has less accuracy by 28% due to the basic antenna used with integrated Arduino controller to detect the electromagnetic wave. In conclusion, the electromagnetic radiation has a direct effect; especially in long-term may lead to the changes in physiological indices and body immune function. The consequences of this investigation likewise showed that joined impacts of Wi-Fi in addition to cell phone presentation have a higher potential to cause a lot of hurtful impacts.

***Keywords**:* Electromagnetic wave exposure (EWP), Human body, electromagnetic radiation awareness, Radiation Hazard.

1. Introduction

Electromagnetic contamination has been expanding a result of every day remote correspondence (Mobile telephones, PCs, tablets, brilliant timekeepers, toys, games, films, Wi-Fi and so on.). The current circumstance in regular day to day existence has been causing open and logical worry on the impacts of radiofrequency radiation (RFR) on human wellbeing. Lamentably, most logical information on electromagnetic contamination affirms these worries. Accordingly, RFRs have been delegated 'Gathering 2B (Possibly cancer-causing)' by The International Agency for Research on Cancer, a part of the World Health Organization, as a result of the seriously gathering logical proof on the connection between cerebrum tumours and RFRs [1].

Body wellbeing portrayal plays one of the most significant jobs in life; there has been a huge development in the utilization of gadgets that produce electromagnetic radiation for personal purposes [2]. Shockingly, gadgets consistently accompany a high danger to human life. Since the start of the twentieth century, one has been encircled with a high level of electromagnetic vitality because of the emotional development of intensity frameworks, radio and TV channels, radars, base stations, phones, various household apparatuses, and machines, at home and workplaces [3]. Nonetheless, the nearness of electromagnetic fields in nature has become a basic aspect of our general public through their different applications, there has been an expanding concern related with the conceivable wellbeing impacts that could exist because of the presentation to these fields [4],[5]. Particularly in our homes, the vast majority use phones and numerous gadgets that rely upon Wi-Fi, thus, these gadgets will radiate an electromagnetic field, which on a specific level will influence the human body and mind [6],[7],[8]. The point is to mindful open concerning bio impacts, because of the electromagnetic field introduction and to manufacture a gadget that decides the electromagnetic field level and advise the client if the level could prompt medical problems. This investigation will add to the improvement of danger avoidant in the day by day radiation introduction

During ongoing years, the utilization of cell phones has expanded significantly and has been resembled by a developing worry about the impacts on wellbeing ascribed to introduction to the electromagnetic fields delivered by them and their base stations.

Exhibiting that radiation causes unfriendly consequences for wellbeing would flag a far and wide general medical issue.

Since the first discovery of electromagnetic waves and propagation, people have feared of uncertain dangers. As technology developing the dangers is becoming more complex to identify. Such complexity is present in electromagnetic waves which could be harmful in many ways, such as short term exposure to ionizing radiation, which can cause mutations in DNA or long term exposure to cell phone radiation, which can cause infertility in men [9].

The primary objective of this research exploration will empower the father of the family to be attracted to this new approach for estimating EMF presentation and to utilize it as a successful methodology that will profit the family from wellbeing hazard. The results to be viewed as comprising of the accompanying: the improvement of demeanour while utilizing gadgets which produce electromagnetic waves; the advancement of a positive intuition towards innovation to quantify the degree of EMF at home [10].

In 2017, Chao Yu and Rui-Yun Peng investigated on an examination among labourers presented to microwave or high recurrence radiation in the workshops to test the serotonin and the melatonin level on those labourers contrasted with different specialists who weren't presented to high recurrence radiation. He found that labourers who work under high recurrence radiation, level of the serotonin has expanded while the degree of the melatonin has diminished, which can cause fretful legs, rest issues and changes in temperament [11].

2. Methods

2.1. Radio Frequency Radiation Effects

The telephone is a relational specialized apparatus, concocted by the world Bell, one reason for the improvement of correspondence between individuals, where the job of a cell phone when all is said in done was to spare time and utilization of innovation for the comfort of humankind, and his appearance was viewed as a forward leap in the methods of correspondence between individuals, yet his essence was at first restricted to a specific classification of individuals and afterwards continuously spread and advance [12].

Cell phones are gadgets that send low radio waves and don't devour an enormous measure of vitality; they work at frequencies somewhere in the range of 450 and 2700 MHz and a most extreme force somewhere in the range of 0.1 and 2 watts. The telephone communicates power just when it is turned on [13].

The force level (and henceforth the client's presentation to radio recurrence) will rapidly diminish when you move away from the telephone. Individuals who utilize a cell phone 30 to 40 centimetres from their body - when composing a short message, getting to the Internet or utilizing a sans hands speaker - are considerably less presented to radio recurrence (RF) fields than individuals who stick the telephone to their heads [14].

2.1.1 Cell Phone Effects

Tissue overheating is the main interaction mechanism between RF energy and the human body. Due to the frequencies utilized by cell phones, the vast majority of the vitality is consumed by the skin and other surface tissues, bringing about a little increment in cerebrum temperature or different organs. Epidemiological research to identify long-term risks from exposure to radio frequencies has essentially explored the relationship between brain tumours and mobile phone use [15]. Damage to cardiovascular health, as radiation from the phone, affects haemoglobin-carrying RBCs and therefore increases the risk of heart disease.

2.1.2. WIFI effect

Everyone should know that the factor that usually installs Wi-Fi in the homes has specific instructions to reduce Wi-Fi damage to its health, as Wi-Fi can be considered as the silent killer that kills us slowly. In recent years, it can be used to connect to the Internet via phone, tablets, and computer and of course several other devices. Waves emitted by the Wi-Fi device can cause serious damage to our health and often ignore this fact because we know almost nothing about the dangers of Wi-Fi. A study by the UK's Health Protection Agency found that waves prevented the growth of both humans and plants. Direct exposure to wireless Internet waves or “Wi-Fi” adversely affects the brain, resulting in a lack of concentration, and sometimes even pain in the ears [16]. A study conducted at the University of Cambridge suggests that RF leads to difficulty in pregnancy; besides, pregnant women should be cautious about using wireless devices, because frequent exposure to radiation can lead to miscarriage.

Although Wi-Fi is harmful to human health, we need to take some measures to minimize its damage, such as turning off Wi-Fi before going [17]. To bed to sleep, it is also advisable to turn it off when not pilgrim in the daytime it is advisable not to put the device "Wi-Fi" in the kitchen and the bedroom.

2.2. Microwave Ovens

The microwave radiation is produced inside the oven, while the radiation is being reflected within the metal interior of the oven the food will absorb the radiation, the radiation will cause water molecules in the food to vibrate, producing heat that cooks the food. The problem is microwave radiation can heat body tissue the same way it heats food [18]. Exposure to high levels of microwaves can cause a painful burn. The exposure could be a result of leakage of radiation, such as a hole in the metal interior.

One of the most important research done by Ahsan Kalyar (2016), focusing on the effect of Microwave Radiations on human health. This examination centered the feature of ingestion of the electromagnetic radiations by the human body and the negative impacts on the human wellbeing brought about by these radiations. The investigation depends on past examinations and genuine analyses on human and creatures that referred to in the paper. [19] There are negative impacts of the electromagnetic radiation particularly in radio recurrence field that utilized in the correspondence frameworks, radio, TV, cellular frameworks, and inside resolutely frameworks.

2.3. System Design and Radiation Pattern

This research is interested in electromagnetic radiation and human body effect through wireless wave propagation, implicated with various wireless device impairments; consequently, wireless access points and other equipment’s are considered. Tests will be conducted to measure the level of electromagnetic radiation, and its affect. The electromagnetic waves radiation from all devices located at home were specified by the index value and the received signal strength of all the connection by the electromagnetic sensor will measure in terms of the received signal strength indicator. Consecutively for these index values have index factors in measuring signal strength level. Figure (1) represents the operation carried out on the element of data collection from the literature review and relevant measurements. It contains a series of

process in brief descriptive label describing the process being carried out on the data to generate the design.

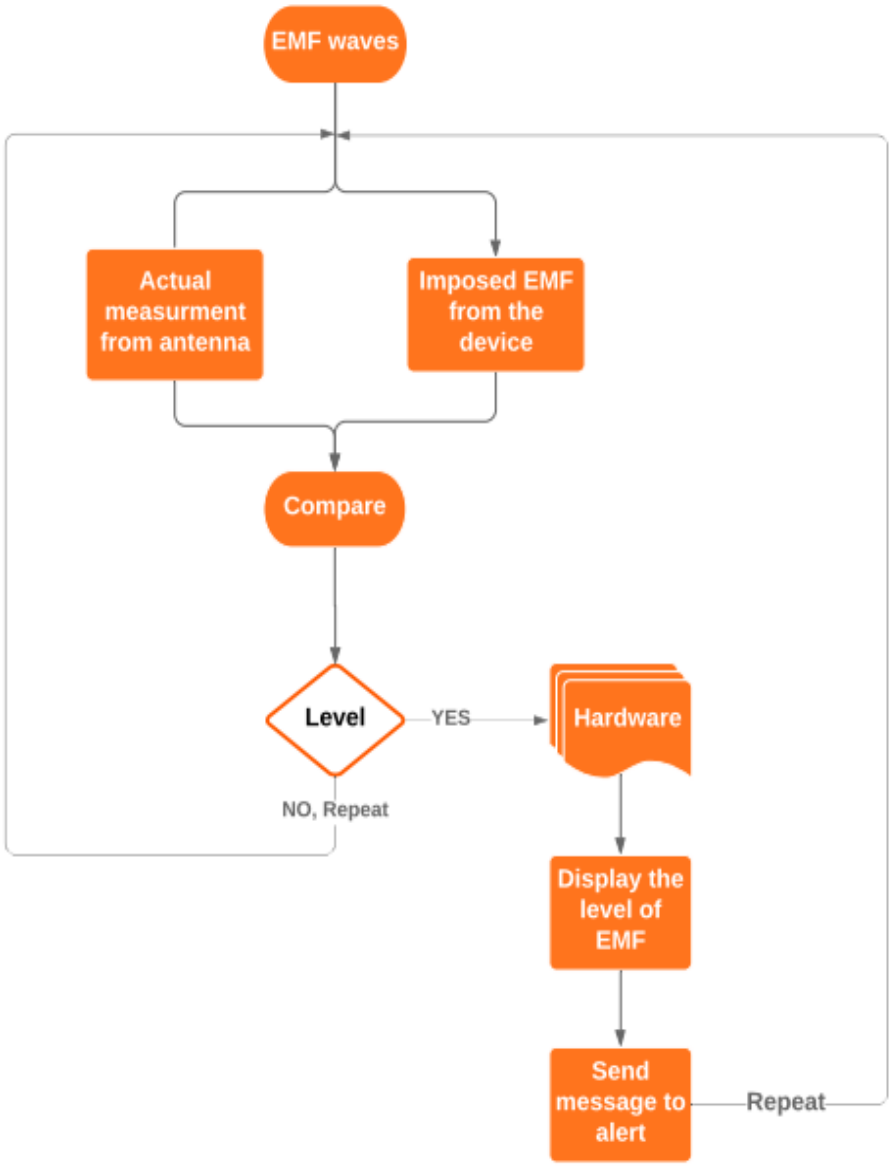

Fig. (1). Schematic flow chart diagrams representing the proposed solution

The radio-recurrence EMF at Figure (2) introduced the frameworks which presented the system operation and given by the establishment to retain the Information Technologies in Culture and are shown in details.

The EMF signal level in the waveguide was observed by the Arduino, that joined into the external antenna and the GSM model send to the allocated number a generator output message to sustain the target field strength.

The Schematic diagram for system design shown in Figure (2) has a very high effective component will respond to any electromagnetic exposure that might be detected on the input signal.

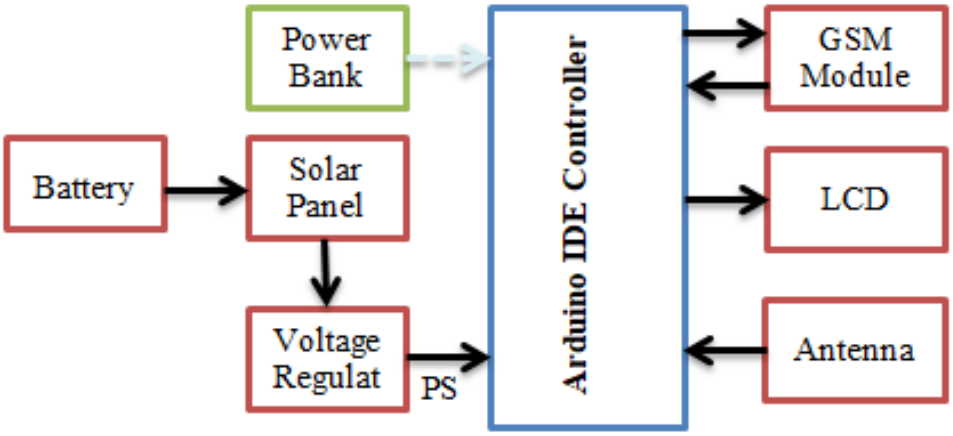

Fig. (2). The schematic diagram for system design

The main aim of the flowchart started in Figure (2) is dedicated for hardware design steps and process through measurement steps, training parameters (electromagnetic waves accumulated at home via different devices) in conjunction with the expected wave exposure to attain higher accuracy of radiation level. The best prediction values will be attained when the sensor will configure with the alert message and device beep when it reaches the maximum value prediction.

2.4. Data Collection

The electromagnetic spectrum is divided into two portions; the high-frequency ionizing waves that are instantly damaging the body by splitting molecules and ionizing atoms. While on the other hand, the lower frequency contains even visible light, infrared signal, microwaves oven and enormously low-frequency waves. While these non-ionizing waves are weaker, but they still can alter cells on a biological level after a long period of exposure. And these non-ionizing waves are our concern because these waves are everywhere now. Our mobile devices emit extremely low frequencies just when they're turned on as well as radio frequencies, they connect to wireless networks and if we carry our radiation-emitting devices close to us all day long, we could be putting ourselves at risk to a lot of negative health effects.

2.5. Radiation Level Decision

Radiation is only an extravagant word for vitality that engenders out from a source in waves. This incorporates electromagnetic radiation, for example, radio waves, microwaves, noticeable light, and x beams. It likewise incorporates certain components which rot normally after some time, creating high-vitality radiation as alpha particles, beta particles, and free neutrons.

At the point when we're attempting to decide whether a radiation source is unsafe to people, we see two factors: The quality of the electromagnetic field encompassing the article (i.e., how much radiation), and "vitality level" of the radiation waves, which is attached to their recurrence (higher recurrence waves pack more vitality). Stuff that can harm natural tissues or DNA straightforwardly is called ionizing radiation. This incorporates high-vitality electromagnetic waves gamma beams, x-beams, and the higher aspect of the UV range and vivacious particles created by radioactive decay as shown in Figure (2).

3. Research Findings

Cell phones have been in broad use for a generally brief timeframe, and their innovation has continuously changed, from simple to computerized frameworks. Cell phones and base stations discharge radio recurrence or microwave radiation. Presentation to such radiation could influence wellbeing legitimately. The utilization of cell phones likewise brings about aberrant impacts, for example, auto collisions and obstruction with wellbeing gear.

Epidemiological examinations when all is said in done populaces, for example, networks, focus on a potential causal connection between cell phone use and the event of mind tumours, acoustic neuromas, tumours of the salivary organs, and leukaemia and lymphomas. Albeit feeble and uncertain, a large portion of the proof accessible doesn't propose that there are unfavourable impacts on wellbeing owing to longterm introduction to radio-recurrence and microwave radiation from cell phones. Be that as it may, ongoing investigations have announced an expanded danger of acoustic neuroma and some cerebrum tumours in individuals who utilize a simple cell phone for over 10 years. Likewise, no information is accessible on the multiplication of these impacts when advanced cell phones are utilized. At last, there is acceptable proof that

the utilization of cell phones while driving converts into a significantly expanded danger of an inadvertent crash.

4. Results and Discussion

The proposed project designed to detect the hazardous levels of the electromagnetic wave at home, by sending a warning message to indicate the risk incidence. The devices trigger the level of the electromagnetic wave and compare it with the radiation exposure level defined as a rating factor (≤100). Therefore, the device needs to measures the continuous activated electromagnetic waves in the demonstrated area and displays the real-time value through the LCD integrated with the Arduino device. Based on the project design idea, if the detected level of electromagnetic waves exceeded the optimal level, then a warning message will appear to alert the user to switch off the part of the devices to reduce the risk level and send SMS through the GSM module to the family member. The component used to design this project was built based on Arduino kid, GSM module integrated with a basic antenna to detect the electromagnetic waves, and Liquid Crystal Display (LCD) for corresponding electromagnetic level. It was very hard to program the whole scenario in the Arduino chip to function in real-condition to achieve the desired approach. Finally, the goals of this research design have been accomplished with a high success rate.

When the actual device is turned on it shows the white light. In Figure (3), the detect level is 60 that is below 100, thus, no warning message and the LED is light.

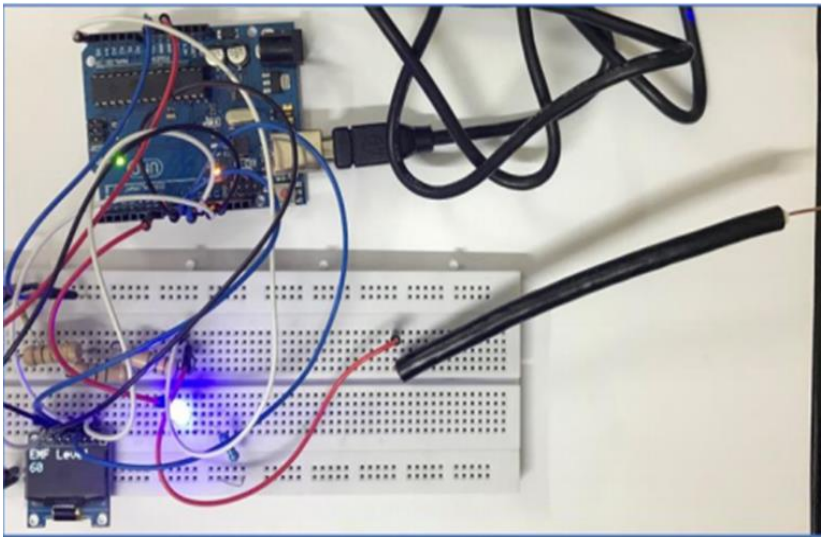

Fig. (3). The detected hazard in the normal case

In Figure (4), obtain the level of the electromagnetic wave to 120, which considered above 100 dues to the multiple access point and nodes near the antenna, therefore the warning message is displayed in addition to the LED too bright to draw the attention of the user.

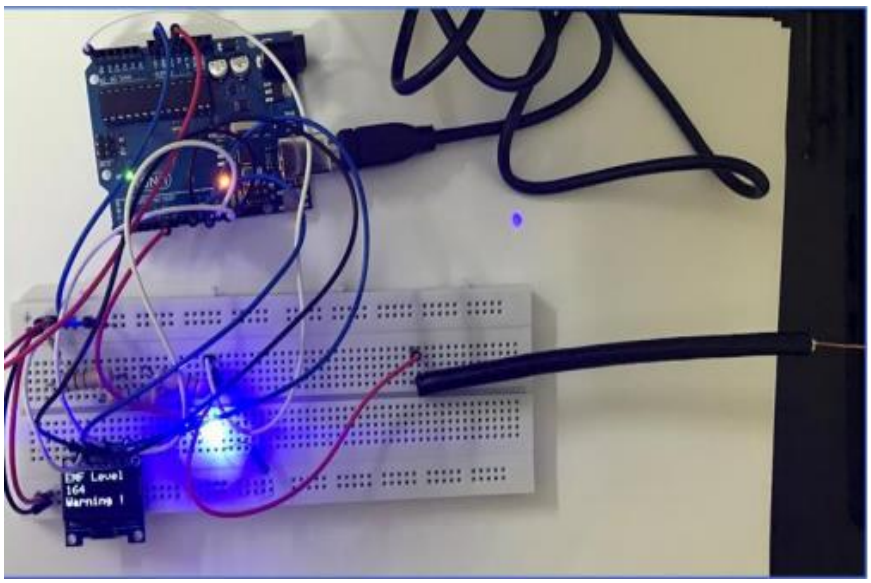

Fig. (4). Increasing the level of EMF

In Figure (5), shows the level the electromagnetic wave to 146 which considered very dangerous in long term dues to the operating many mobiles beside the antenna, therefore the warning message is displayed in addition to the LED too bright to draw the attention of the user and send message to the family member to aware the hazard to them.

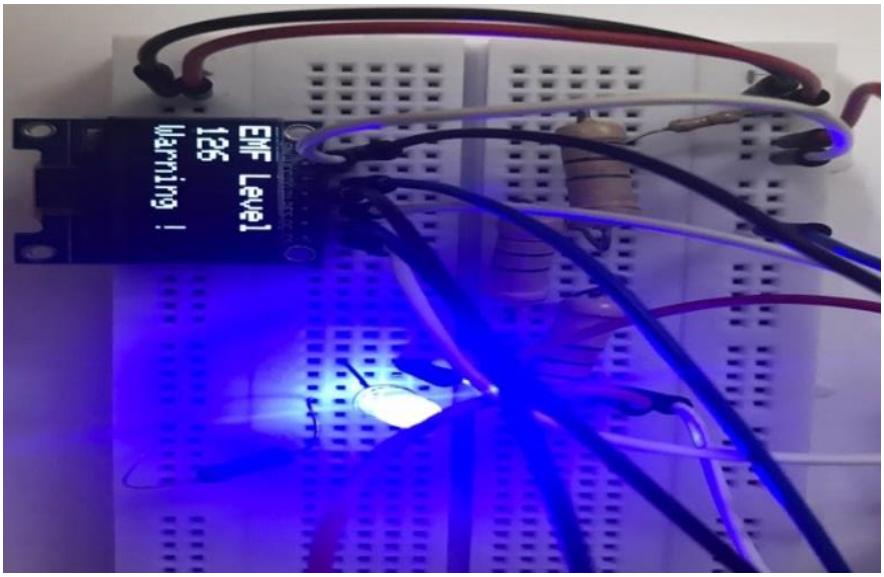

Fig. (5). Device operation and warning case

The success rate of the device shown in Figure (6) characterized the rate as the number of times out of a trail of 25 that the device completed the accurate trigger. This is a truly coarse measurement; using the simplest explanation to configure the results in a short time or how well they play out the errands they completed.

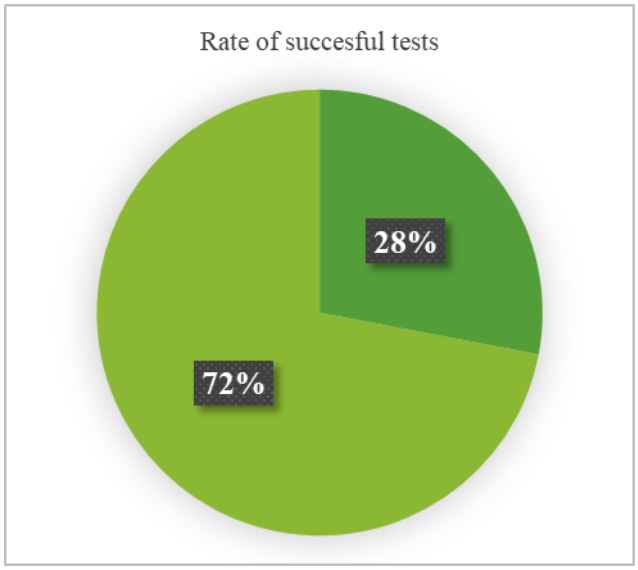

Fig. (6). Rate of successful test

5. Conclusion

This paper summarized the adopted methodology for the project with a flow chart, which symbolized the proposed solution. The design provided the details of data collection according to the schematic flow chart diagrams representing the proposed solution to trigger the hazard of the electromagnetic wave exposure in the body for a long or short time. Also, this paper discussed the level of radiation that can harm the human body which detailed in the Figures to be above 100. Finally, it described the hardware design and the required component. To provide more accurate data you need to design a multi-band antenna to trigger the entire hazard around the human including high frequency.

It's suggested that labourers in any offices ought to know whether they work at high frequencies by not presenting themselves to the radiation recurrence

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تصميم جهاز للكشف عن التعرض للموجات الكهرومغناطيسية لجسم الإنسان

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(قدم للنشر في 2020/9/1 وقبل للنشر في 2020/10/3)

ملخص البحث. يعد انتشار الموجات الكهرومغناطيسية لأجهزة الاتصال الشخصية في المنزل مصدر قلق في البحث الحالي. على وجه الخصوص ، هناك عدد كبير من المنشورات التي تمت مراجعتها من قبل الباحثين والتي تظهر أن الهاتف المحمول والواي فاي يعرضان الجسم ويحدث بعض المشاكل المزمنة لجسم الإنسان. الهدف الرئيسي من هذا المشروع هو تصميم وتحليل تأثير التعرض الكهرومغناطيسي على جسم الإنسان بناءً على معدل المستوى البالغ 100 عبر التقييم التلقائي للجهاز واستراتيجية الإنذار. تظهر النتيجة أن ، قيمة كبيرة للتعرض للموجة الكهرومغناطيسية تم قياسهاوكان معدل النجاح 72٪ خلال 25 مرة من الاختبار. ومع ذلك ، فإن دقة النظام أقل بنسبة 28٪ بسبب عدم تصميم الهوائي الأساسي (Antenna) المستخدم مع وحدة تحكم Arduino المدمجة للكشف عن الموجة الكهرومغناطيسية. في الختام ، للإشعاع الكهرومغناطيسي تأثير مباشر على جسم الانسان؛ خاصة على المدى الطويل قد يؤدي إلى تغيرات في المؤشرات الفسيولوجية ووظيفة مناعة الجسم. أظهرت عواقب هذا التحقيق أيضًا أن التأثيرات المشتركة لشبكة Wi-Fi بالإضافة إلى التعرض للهاتف الخلوي لديها احتمالية أكبر للتسبب في الكثير من التأثيرات الضارة.