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Detection and Estimation of Pesticides Residue Using a Smart Pen

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Abstract: - Pesticides are chemical substances applied to crops at various stages of cultivation and during the post-harvest storage of crops. The use of pesticides is intended to prevent the destruction of food crops by controlling agricultural pests or unwanted plants and to improve plant quality. Pesticide use in commercial agriculture has led to an increase in farm productivity. Despite the wide ranging benefits of using pesticides in agriculture, several incorrect applications can result in high and undesirable levels of the compounds that produce that reaches consumers. These include inappropriate selection of pesticides used on foodstuffs, over use of pesticides and harvesting the crops before the residues have washed off after application. Monitoring of pesticides in fruit and vegetable samples has increased in the last years since most countries have established maximum residue level (MRL) for pesticides in food products. With the gradual advance of urbanization construction, the procurements of vegetables and fruits are most in markets and supermarkets. However, these procurement locations almost have no pesticide residues detection devices. Gas chromatography (GC), liquid chromatography (LC) or combinations (GC-MS or LC-MS/MS) are traditional analytical techniques for identification and quantity determination of pesticides residues. Although these methods offer quantitative analysis with sensitivity and selectivity, they are slow, expensive, laborious and not convenient to popularize and promote. Moreover, they don't have the ability of information sharing and remote control. Therefore, we had planned to come up with a new instrument that is the apt one for this explosive global world. Where it serves with the hyper connected IOT. The fluorescent cyclodextrin is injected into the pen and then the amount of pesticides is estimated using a Bluetooth or a digital meter. Many technologies serve as the building blocks of this new paradigm such as QR barcode,cloud services,machine to machine(M2M), and so on. Also, these application domains The IoT we used in this pesticide residues detection system based on the pesticides detection. Due to the above, the purpose of this investigation is to design a system for pesticide residues detection and agricultural products traceability. We intend to allow anyone to interconnect this system with a Bluetooth device. This smart pen can be used in supermarkets, markets and plantations and with food inspectors. Moreover, this system also can be used in the areas of purchasing, storage and transportation, and in house.

Key Words— ***smart pen, pesticides, vegetables and fruits, Bluetooth.***

I. INTRODUCTION

Pesticides are substances that are meant to control PESTS including weeds. The term pesticide includes all of the following: herbicide, insecticides (which may include insect growth regulators, termiticides, etc.) nematicide, molluscicide, piscicide, avicide, rodenticide, bactericide, insect repellent, animal repellent, antimicrobial, and fungicide. But they must be used in a very little but some malusers they use in a high amount and because of this we are unable to produce the best quality products and we face many problems in our day today life. So to fix this problem we had designed a smart pen which works according to our will and wish and also it is able to detect and estimate the amount of pesticides very rapidly. It is not done in a very slow process it gives the rapid answer, as the world is in the hyper connected colony. Let us discuss about this in the following lines.

Pesticides Usage:

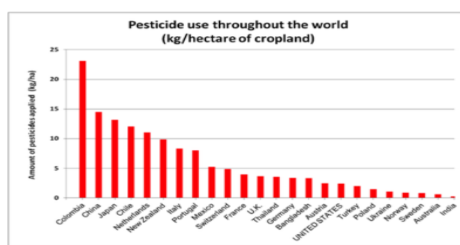

Fig.1. Pesticide use throughout the world

The most common of these are herbicide which account for approximately 80% of all pesticide use. Most pesticides are intended to serve as plant protection products (also known as crop protection products), which in general, protect plants from weeds, fungi, or insects. In 2006 and 2007, the world used approximately 2.4 megatonnes(5.3*109lb) of pesticides, with herbicides constituting the biggest part of the world pesticide use at 40%, followed by insecticides (17%) and fungicides (10%). In 2006 and 2007 the U.S. used approximately 0.5 megatonnes (1.1×10^9 lb) of pesticides, accounting for 22% of the world total, including 857 million pounds (389 kt) of conventional pesticides, which are used in the agricultural sector (80% of conventional pesticide use) as well as the industrial, commercial, governmental and home & garden sectors. The state of California alone used 117 million pounds. Pesticides are also found in majority of U.S. households with 88 million out of the 121.1 million households indicating that they use some form of pesticide in 2012. As of 2007, there were more than 1,055 active ingredients registered as pesticides, which yield over 20,000 pesticide products that are marketed in the United States.

The US used some 1 kg (2.2 pounds) per hectare of arable land compared with: 4.7 kg in China, 1.3 kg in the UK, 0.1 kg in Cameroon, 5.9 kg in Japan and 2.5 kg in Italy. Insecticide use in the US has declined by more than half since 1980 (0.6%/yr), mostly due to the near phase-out of organophosphates. In corn fields, the decline was even steeper, due to the switchover to transgenic Bt corn.

For the global market of crop protection products, market analysts forecast revenues of over 52 billion US$ in 2019.

Health Defects:

Pesticides may cause acute and delayed health effects in people who are exposed. Pesticide exposure can cause a variety of adverse health effects, ranging from simple irritation of the skin and eyes to more severe effects such as affecting the nervous system, mimicking hormones causing reproductive problems, and also causing cancer. A 2007 systematic review found that "most studies on non-Hodgkin lymphoma and leukemia showed positive associations with pesticide exposure" and thus concluded that cosmetic use of pesticides should be decreased. There is substantial evidence of associations between organophosphate insecticide exposures and neurobehavioral alterations. Limited evidence also exists for other negative outcomes from pesticide exposure including neurological, birth defects, and fetal death.

The American Academy of Pediatrics recommends limiting exposure of children to pesticides and using safer alternatives:

Owing to inadequate regulation and safety precautions, 99% of pesticide related deaths occur in developing countries that account for only 25% of pesticide usage.

One study found pesticide self-poisoning the method of choice in one third of suicides worldwide, and recommended, among other things, more restrictions on the types of pesticides that are most harmful to humans. A 2014 epidemiological review found associations between autism and exposure to certain pesticides, but noted that the available evidence was insufficient to conclude that the relationship was causal.

Large quantities of presumably nontoxic petroleum oil by-products are introduced into the environment as pesticide dispersal agents and emulsifiers. A 1976 study found that an increase in viral lethality with a concomitant influence on the liver and central nervous system occurs in young mice previously primed with such chemicals.

The World Health Organization and the UN Environment Programme estimate that each year, 3 million workers in agriculture in the developing world experience severe poisoning from pesticides, about 18,000 of whom die. According to one study, as many as 25 million workers in developing countries may suffer mild pesticide poisoning yearly. There are several careers aside from agriculture that may also put individuals at risk of health effects from pesticide exposure including pet groomers, groundskeepers, and fumigators.

Pesticide use is widespread in *Latin America*, as around US$3 billion are spent each year in the region. It has been recorded that pesticide poisonings have been increasing each year for the past two decades. It was estimated that 50–80% of the cases are unreported. It is indicated by studies that organophosphate and carbamate insecticides are the most frequent source of pesticide poisoning.

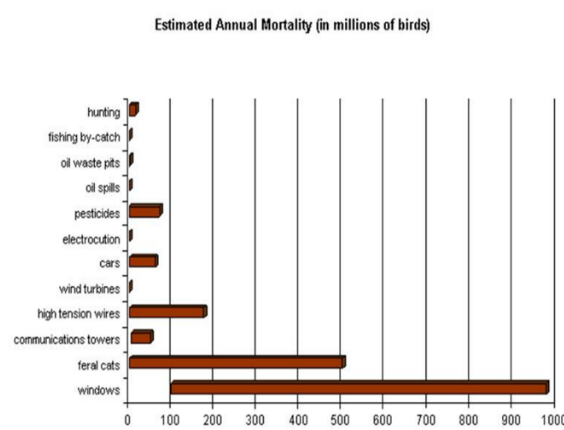

Fig.2. Estimated Annual Mortality.

Fixing Problem:

To fix this problem it is needful for us to work smartly. The traditional use of gas chromatography, liquid chromatography consumes more time and it also gives only the quality checking, but here we need both the quantity and the quality. It is a very easy equipment to carry and also to Use. It avails us more that it is the best use and the smartest use in which, it is easy for the food inspectors to use and find the malusers. It is the smart pen that detects the amount of pesticide residue present in the fruit and the vegetables. Thus it reduces our time and effort and also it gives the correct accuracy of pesticides residue.

Fig.3. Smart Pen

II. METHODOLOGY

PEN

CLICKING THE BACKSIDE OF PEN

FLUORESCENT CYCLODEXTRIN RELEASES ON SAMPLES

BINDING OF CYCLODEXTRIN WITH PESTICIDES.

CALCULATION OF PESTICIDES

DECIDING WHETHER IT IS ACCEPTABLE OR NOT.
THUS THE PEN WORKS.

A. Metals Used

The metal used for the pen is nickel. This metal is used so that the fluorescent cyclodextrin will not react with it.

Fig.4. Nickel

B. Light Source

Fluorescent cyclodextrin is used in the pen which is used as a molecular scanner, the cyclodextrin produces about 1-50Hz as gamma ray

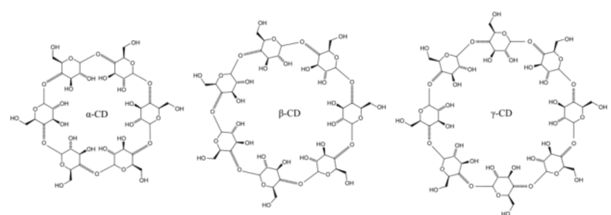

Fig.5. Cyclodextrin

Fig.6. Molecular Scanning

Therefore, gamma cyclodextrin has the ability to estimate and eliminate pesticide from food samples and can help in exhausting the malusers.

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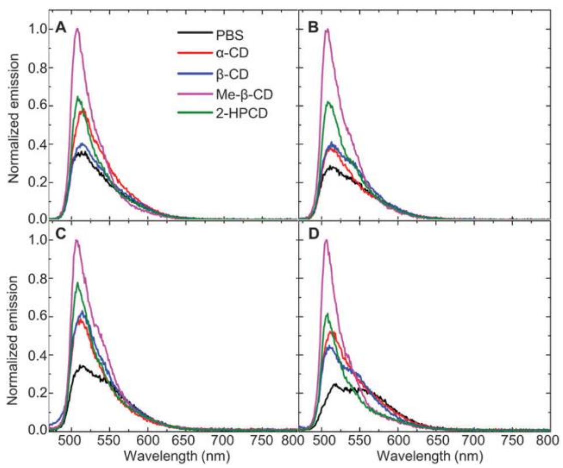

Fig.7. Frequency of different Cyclodextrins

Cyclodextrin binding pesticides:

The binding constants of SEVEN commonly used pesticides are :

S.NO	Pesticides	Fruit/vegetables
1	2,4 D acetochlor	Corn, soya bean.
2	Acetochlor	Sugar beets
3	dicamba	Grapes ,tomatoes
4	dimethanamide	Sweet corn, peanuts
5	Metolachlor	Apples, grapes
6	propanil	Herbs.
7	Nitrates and nitrides	Raddish, gooseberries, water melons.

C. Bluetooth or Digital Meter

The pesticides that are bound together will be found out using a digital meter or a bluetooth being connected to a mobile.

Fig.8. Digital Meter

D. Laws Used: Newtons Second Law of Motion

Newton's second law of motion

- The rate of change of momentum p is proportional to the force applied to make the change and takes place in a straight line
- Consider a body having initial velocity u at time t= 0 and reaches a velocity v after a time t. Change in momentum is $\nabla p = mv - mu$

The rate of change of momentum is

$$\frac{\nabla p}{\nabla t} = F = mv - mu = m\frac{dv}{dt} = kma, k = 1 \rightarrow F = ma$$

Thus when we press the pen force is converted to momentum, which in turn the light is released from the pen.

E. Diagrammatic Representation

The diagrammatic representation of the working is as follows.

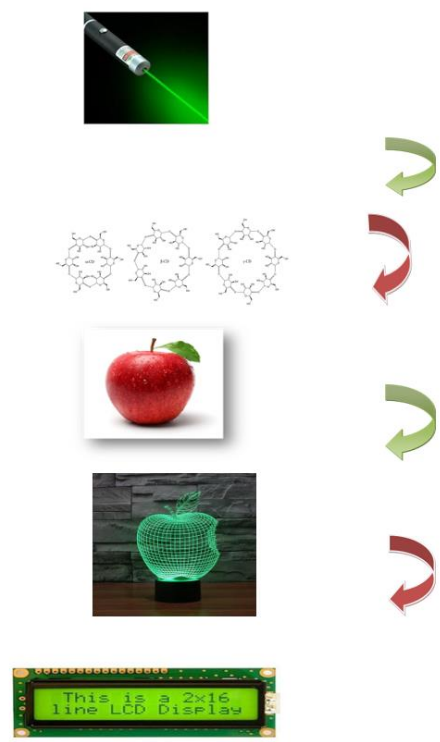

Fig. 9. Working flow Diagram

These are the steps we followed

1. When the penis clicked force acts on fluorescent cyclodextrin and according to the newtons second law of motion,the force is converted to momentum where the light gets emitted from the pen.
2. Fluorescent cyclodextrin
3. After the tiggering of fluorescent cyclodextrin light is emitted on the fruits or vegetables given
4. Molecular scanning is done in which there are certain cyclodextrin binding pesticides are there and it binds with pesticides
5. Where the amount of pesticides is detected through the digital meter. And thus we can find whether the fruits are safe to use

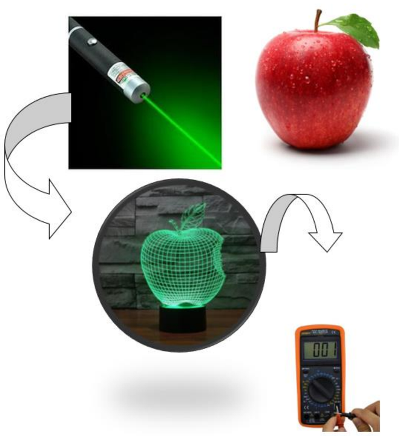

Fig.10. Over all flow diagram

III. Results And Discussion

Thus the pen is designed in a very easiest manner and let us now see about the cost and it is the cheap cost.

COST ESTIMATION

Materials used	price ₹
Fluorescent cyclodextrin	1000
Metal used-nickel	500
Total	1500

Fig.11. Estimated cost

A biosensor is universally defined as "a self-contained analytical device that combines a biological component with a physicochemical device for the detection of an analyte of biological importance". We know that cyclodextrin is similar to a molecular scanner. It consists of a biological recognition element which is able to specifically interact with a target molecule and a transducer able to convert this interaction into a measurable signal.

Chemical biosensors are based on the presence of a biological element, which is specific for the analyte, and stable under normal conditions of use and storage. Numerous recognition elements have been used in biosensors, such as receptors, nucleic acids, whole cells, antibodies and different class of chemicals. cyclodextrin in our device just works similar to the above mentioned chemical biosensors. construction of the device is also economically advisable.

IV. Conclusion

Finally, we conclude that by using IoT based monitoring the pesticides in fruits and vegetables. Detecting the pests present in fruits and vegetables or any residues present through the pest detection sensor it senses and passes the information to the display in an LCD placed there. By detecting through the process it informs that how much residues of pests present so that the fruits and vegetables are washed more than twice still it reaches to 0.01%. The application of this pesticides residues detection instrument has been performed on real samples. The system showed to be successful in pesticide residues detection and agricultural products traceability. For cholorpyrifos extracts, the detection system based on molecular scanning permitted to determine concentrations of 2μg/L, thus indicating the performance of this system can satisfy the pesticide residues detection and information sharing requirement of real vegetables and fruits samples. The detection system based on molecular scanning and IoT for pesticide residues detection can be used in every link in the agricultural products traceability.

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