THE CONTRIBUTION OF DIGITALIZATION IN THE DEVELOPMENT OF ASTRONOMY IN INDONESIA

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Abstract

The Development of technology has a major impact on the development of Astronomy. The focus of this research is to analyze the impacts of the digitalization era on the development of Islamic astronomy discourses in Indonesia. This research is library research with a qualitative approach which aims to find out how the contribution of technology in the development of astronomy in Indonesia. The author's data sources in this study are scientific notes either in the form of books or notes from electronic media. The results of this study indicate that astronomy practitioners have made a new breakthrough in the development of astronomy, namely creating digital data-based applications to assist calculations. This scientific collaboration with technology and digitalization creates a harmony between astronomy and technology, thus making the study of astronomy in Indonesia more accommodating to digital era instead of just revolving around the study of science and religion.

Keywords: *Digitalization*; *Islamic Astronomy*; *Indonesia*

Abstrak

Perkembangan teknologi memiliki pengaruh besar dalam perkembangan Ilmu Falak. Fokus penelitian ini yaitu menganalisis pengaruh era digitalisasi pada perkembangan ilmu falak di Indonesia. Penelitian ini merupakan penelitian studi pustaka (*library research*) dengan pendekatan kualitatif yang bertujuan untuk mengetahui bagaimana kontribusi teknologi dalam perkembangan Ilmu Falak di Indonesia. Sumber data penulis dalam kajian ini adalah catatan-catatan ilmiah baik dalam bentuk buku ataupun catatan dari media elektronik. Hasil penelitian ini menunjukkan bahwa, para praktisi falak telah membuat sebuah terobosan baru dalam pengembangan ilmu falak yaitu memunculkan aplikas-palikasi berbasis data digital dalam membantu perhitungan. Kolaborasi keilmuan dengan teknologi dan digitalisasi ini menciptakan sebuah keharmonisan antara Ilmu Falak dan teknologi, sehingga membuat kajian Ilmu Falak di Indonesia lebih mengakomodir perkembangan zaman alih-alih sekadar berputar pada kajian sains dan agama saja.

Kata Kunci: *Digitalisasi; Ilmu Falak; Indonesia.*

A. Introduction

The world has entered the digital era, namely an era in which an era that has been converted into digital form in various aspects of life. Developments in this digitalization era greatly affect various aspects of daily life. Especially how technology makes humans easier, more practical and efficient in carrying out various activities. One of them is the use of technology in the realm of science, for example in Astrology. In fact, in practicing various kinds of knowledge in Astrology, in which there are 6 sub-chapters that are the focus of the study, such as determining the Qibla direction, determining the beginning of prayer times, determining the beginning of the Hijri month, lunar eclipses, solar eclipses and Hijri calendar. The calculations in Astrology have a fairly long and complicated calculation, so it takes time during the calculation process.

Through the use of technology in this digitalization era, astronomy practitioners compete in channeling their respective ideas to create astronomy applications as a shortcut to the problems they are experiencing, so as to make it easier for both students and the community in solving problems that occur in the world. field easily and practically. This does not mean that the proliferation of digital applications has made learning related to Astrology to a halt and it is becoming rare to learn. But this digitization is only a form of convenience to find out the results of astronomy calculations, while the process of meaning and study must continue to be carried out and scientific treasures must continue to be developed.

In fact, it's not just about applications, but now there are more and more observatories and planetarium developments to support the progress of learning for students and the general public in studying astronomy. Like Biology, Chemistry and Physics lessons and even social sciences, they have a place for experimenting (called a laboratory), Astrology is also not left behind in having a place for observing different celestial phenomena to activities and observations of the early crescent moon in determining the beginning of the *Hijrī* month (*ru'yah al-hilāl*) is the observatory and planetarium. [1]

[1] Widya Sawita, "Peran Planetarium dalam Penguatan Studi Ilmu Falak di Perguruan Tinggi Keagamaan Islam" (Jakarta, 2022), 5.

Based on the various efforts of astronomy practitioners in collaborating astronomy with technology in this digital era, the researchers seek to examine the contribution of digitization in astronomy, so that by digitizing astronomy they can build a new civilization towards a golden Indonesia 2045.

B. Method

This research is a library research with a qualitative approach which aims to find out how digitization contributes to the development of astronomy in Indonesia. The analytical method that the author uses in this study is a qualitative descriptive analysis method, namely the researcher will conduct an in-depth analysis to draw a conclusion from the author's findings regarding the contribution of digitization in the development of astronomy in Indonesia. The author's data sources in this study are scientific notes in the form of books or notes from electronic media.

C. Result and Discussion

C.1 A Brief History of the Development of Astronomy

Astronomy has received a lot of attention from researchers and historians. Regis Morlan (a French orientalist, researcher on the history of classical astronomy) suggests several factors including: the number of scholars who have worked in this field throughout history, the number of works produced, the number of astronomical observatories that stood as access to the many astronomers and the works of astronomers. them, the amount of documented observation data (natural observations). In its early journey, the civilizations of India, Persia and Greece were civilizations that had a special position. From these three civilizations specifically emerged and the birth of the Arab astronomy civilization (Islam), in addition to other civilizations. Indian civilization is strongest in its influence on Islam (Arabic).

a. Pre-Islam

Astrology is a science that has been known to humans for a long time. The Egyptians, Mesopotamians, Babylonians, Chinese, since the 28th century BC have known and studied it. They studied astronomy at first with the aim of producing a count of time, which would be used as a time of worshiping the idols they worshiped. Because

there are many who are God, they need a division of time. And with the necessity of sharing that time, they then studied astronomy.[2]

Before Islam came, the Arabs of Jahili had basic knowledge of events that occurred in the universe. The event is then recorded simply through habit and memory. This kind of activity is something that is usually done by the Arabs of ignorance because of their wandering activities. The Arabs long before Islam had known the science of Falak, where this knowledge was used as a guide in everyday life.[3] Arab society knows and studies celestial bodies (Sun, Moon and stars) more in the nature of practical astrology knowledge for the benefit of carrying out life activities. One of the most important natural clues at that time was the forecast of the seasons, where for these basic needs they recorded the rotation of the seasons based on the circulation of celestial bodies. In addition, the community also determines their important days by using time calculations which later become the Luni-solar calendar system.[4] In this realm, it is sufficient to say that the pre-Islamic community was familiar with astronomy even though it was in a fairly simple stage.

b. Early Islam

Islam came to the Arab community by bringing a new aura from all aspects of life. Islam came to bring fresh air for the advancement of human thought, especially the Arabs at that time. Islam entered and gave color to civilization, especially in terms of the calendar reckoning system, namely changing the system that used to be luni-solar, so Islam changed it to a lunar calendar. And the number of months is set to 12 where previously the Arabs applied the thirteenth month at the end of every leap year.[5] Islam's choice of using the Lunar calendar as a formal Islamic calendar is not purely coincidental, but because of the alignment of Islamic character with the system which is considered easy. In the Lunar calendar, the beginning of the month is determined easily

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[2] Alimuddin Alimuddin, "Sejarah Perkembangan Ilmu Falak," *Al Daulah: Jurnal Hukum Pidana dan Ketatanegaraan* 2, no. 2 (2013): 181–94, https://doi.org/10.24252/AD.V2I2.1475.

[3] Muhammd Hasyim Manan, *Menuju Kesatuan Hari Raya* (Surabaya: Bina Ilmu, 1995).

[4] Departemen Agama RI, *Selayang Pandang Hisab-Rukyat* (Jakarta: Direktorat Pembinaan Syariah dan Hisab Rukyat, 2004).

[5] Ahmad Musonnif, *Ilmu Falak* (Yogyakarta: Teras, 2011), 13.

by simple observation of the Moon. The Prophet gave instructions to early Muslims about *ru'yah*, early instructions for prayer times, Qibla direction, and eclipses. However, in calculating the calendar, the year number is still not used, so it still causes confusion.[6] The development of astronomy in the early days of Islam was very visible, namely during the caliphate Umar bin Khattab where he established a new calendar system (Hijri Calendar) used by Muslims around the world in worship. The foundation for determining this calendar system is based on the Prophet's migration from Mecca to Medina, precisely in the 17th year of Hijrah and with various considerations establishing Muharram as the first month.[7]

On the other hand, the classical Muslim intellectual repertoire of Falak science is one of the characteristics of the progress of Islamic civilization. However, in its journey, Falak science only examines matters of worship, such as the direction of the Qibla, prayer times and the beginning of the Islamic month of Hijri Calendar, marked by the process of translating monumental works from the Greeks which greatly influenced the development of Falak in the Islamic world. At that time the books were not only translated but followed up through continuous research and finally produced new theories.

c. Islamic Triumph

The development of reckoning *ru'yah* at this time was driven by the business activities of translating the works of the Greeks, Persians and Indians in the field of astronomy and astrology which received special attention from the Abbasid caliphs at that time. The rulers of the Abbasids invited and brought experts in Astrology to the palace, this was done to encourage the development of astronomy in the Islamic world. At that time astronomy was more oriented to the theory of astronomy in India, Greece and Persia

[6] Abdul Salam Nawawi, *Rukyat Hisab di Kalangan NU Muhammadiyah* (Surabaya: Diantama, n.d.), 4.

[7] Ahmad Izzuddin, *Fiqh Hisab Rukyat (Menyatukan NU & Muhammadiyah dalam Penentuan Awal Ramadhan, Idul Fitri dan Idul Adha* (Jakarta: Erlangga, 2007), 50.

During the time of the Abbasids, scientific developments seemed to be reaching its zenith, one of the caliphs, Caliph Abu Ja'far al Mansur, placed astronomy as an important science that must continue to be developed. One of his efforts was to translate the Sindihind from India. This book was brought by an Indian astronomer who handed it over to the Caliph Abu Ja'far al-Mansur in Baghdad. The Caliph then ordered that the book be translated into Arabic. This order was then carried out by Muhammad bin Ibrahim al-Fazari, this activity led al-Fazari to become a famous astronomer in the Islamic world.[8] Then at the time of Caliph Al-Ma'mun the Tabril Magesthi script was also translated into Arabic, so that from here emerged the science of reckoning as a branch of Islamic science regarding the determination of the beginning of prayer times, eclipses, the beginning of the moon and the direction of the Qibla. Several important intellectual figures who lived during this period included Sultan Ulugh Beik, Abu Raihan, Ibn Syatir and Abu Mansur al-Balkhiy.[9] The translation of the books of Falak science continues to be intensified. It did not stop there; the translation was also accompanied by research which later also produced new theories in the field of calculate *rukyat*.

d. Modern Era

Islamic scholars not only mastered the science and philosophy they learned from Greek books, but they also added to it the results of their own investigations in the field of science and the results of their thoughts in the field of philosophy. As a result, in the well-known scientific field the name al-Fazzari (VIII century) is stated as the Islamic astronomer who first compiled the astrolabe (a tool that was used to measure the height of stars and so on).

The development of the times, science and technology also ultimately influenced the development of astronomy. Falak science in the modern world has become a very important science, because it does not only involve activities related to worldly life, but also about the provisions for the implementation of worship, both obligatory and sunnah worship. For example, in determining prayer times, the Hijri calendar system to

[8] Muhyiddin Khazin, *Ilmu Falak dalam Teori dan Praktek* (Yogyakarta: Buana Pustaka, 2004), 25.

[9] Izzuddin, *Fiqh Hisab Rukyat (Menyatukan NU & Muhammadiyah dalam Penentuan Awal Ramadhan, Idul Fitri dan Idul Adha*.

the Qibla direction. With many advances in science and technology, the prayer time schedule is easier to determine. Likewise, the Qibla direction which initially used simple tools, has now been based on Android and digital systems. So that with this progress it makes the worship of Muslims easier. Astronomy also plays an important role in making the Hijri calendar system based on the determination of the beginning of the Hijri month, and the calculation of eclipses which has been combined with modern astronomical data. So that we can know the schedules of natural phenomena such as lunar eclipses or solar eclipses even within the next 100 years. This development is an important indication that astronomy is a science that develops and follows the times. The development of astronomy in today's modern world has also made it easier for Muslims to prepare for worship wherever they are.

C.2 Development of Astronomy in the Digital Era

As a classical science, astronomy does not make astronomy a backward science. The development of astronomy in Indonesia is fairly balanced with the current digital era. Astrology practitioners who make a collaboration with technology can create a harmony between astronomy and technology, thus making astronomy not only dwell between science and religion, but also in the realm of technology. The development of technology in this digital era is increasing accuracy in helping the development of astronomy, especially in determining the Qibla direction, the beginning of prayer times, *rukyatul hilal* and so on. With this technology, it can be a tool in calculating and even making it easier to perform worship.

For Muslims in Indonesia, the Qibla direction is based around the northwest direction, or even there are still many mosques that are built with a makeshift Qibla direction, namely with the principle "it is important to face west",[10] and generally Muslims can be guided by the direction of sunset.[11] However, in this digital era, it can be an answer to the confusion faced by the community in determining the Qibla direction and when to pray, especially when in the forest and not knowing the Qibla direction and prayer times. Just as if it continues to rain

[10] Tri Pangestu Utami and Muhammad Awaludin, "Komparasi Arah Kiblat Masjid Kuno Songak dan Masjid Kuno Bayan di Lombok," *Al-Afaq: Jurnal Ilmu Falak dan Astronomi* 3, no. 1 (July 2021): 79, https://doi.org/10.20414/AFAQ.V3I1.3571.

[11] Kevin Rizky Pratama, "Temukan Arah Kiblat yang Tepat dengan Aplikasi Android dan IOS Ini," Tekno.kompas.com, April 2021.

and cloudy, which in the Qur'an the initial determination of prayer times is based on the position of the sun, astronomers have understood this that basically the circulation or location of the Sun is not the same every day, therefore innovation digitization answers this problem with technology to determine the start of prayer times.

Even though technology is familiar in our lives, and it is also not difficult to mix technology with Astrology, there must be high enough attention to the formulas that will be included in the applications that have been made whether these formulas have been used or not. according to the formula in Astrology or not. The accuracy that will be generated by the application depends on the data that will be entered and then processed in the application such as the certainty of location data, both latitude and longitude, as well as the time zone used in each region. As with the calculation of prayer times, high accuracy is needed related to the latitude of the place or the location point of each region, because the slightest difference in the latitude value of the place can affect the accuracy of the application results, resulting in a prayer time schedule that is different from the proper schedule based on the prayer time schedule issued annually by the Ministry of Religion of the Republic of Indonesia.

Meanwhile, the determination of the beginning of the month, whether using *rukyat* or *hisab*, both require observations of celestial phenomena related to sunrise, sunset, horizon and others, therefore this emphasizes the importance of the presence and existence of the observatory.[12]

C.3 Contribution of Digitization in Astronomy

The digitalization of astronomy is a breakthrough from astronomy practitioners in answering problems that have occurred in society. Technology is never separated from human needs, starting from the primary aspect to the tertiary aspect, it always coincides with the word technology, which is able to make human work more effective and practical. Astrology can be coupled with the technology itself, can collaborate and be in line with the development of the technology. For example, prayer times applications that have developed rapidly based on

[12] Muhammad Qorib et al., "Peran dan Kontribusi OIF UMSU dalam Pengenalan Ilmu Falak di Sumatera Utara," *Jurnal Pendidikan Islam* 10, no. 2 (November 2019): 133, https://doi.org/10.22236/JPI.V10I2.3735.

desktop, web and mobile.[13] This is useful to facilitate public access to understand and practice the astronomy discourse. But the existence of technology does not mean having to forget the study and teaching of Astrology itself. But this digitization is only a form of convenience to find out the results of calculations in Astrology.

Many people think that learning about astronomy doesn't need to be studied anymore, because digital astronomy has already fulfilled their needs, whether it's in terms of the Qibla direction and prayer times and so on. When you think about it, if their mindset remains like that how will the continuity of Astrology itself? In fact, astronomy is still not really known among the public. If it stays like that, then the knowledge of Astrology is extinct. Therefore, to avoid the extinction of astronomy, astronomers must always follow the flow of the times. Fight not to become extinct.

Times continue to change over time, technology continues to develop according to the times, even to carry out tawaf and *sa'i* only in the Grand Mosque already utilize technology. In Astrology, the use of technology is not only about the Qibla direction and the beginning of prayer times. But also, the process of *rukyatul hilal* or *hilal* observation. The contribution of astronomy in this regard plays an important role, especially during the months of worship for Muslims in Indonesia, such as the determination of the month of Ramadan (fasting), the month of Shawwal (Eid al-Fitr) and the month of Zulhijah (Eid al-Adha). In the past, when observe could only use classical tools, now the digital era makes the process of observing the *hilal* object easier. With the advancement of technology that is getting faster and faster, giving rise to various kinds of modern tools that are used to observe the new moon.

Even though the use of classical or traditional and modern tools has the same purpose, these modern tools function to amplify and record light which is then processed by the image and enhanced by the contrast of the *hilal*. Due to the very thin shape of the *hilal*, these modern tools can make it easier for the observer. Even no matter how sophisticated the tool is if the natural conditions do not meet the criteria in the *rukyatul hilal*, then the *hilal* will not be observable. Especially if you only have classic or traditional tools. So that if previously the

[13] Tim Program Beasiswa Santri Berprestasi (PBSB) Kemenag RI, *Digitalisasi Ilmu Falak dalam Teori dan Praktik* (Semarang: Alinea Media Dipantara, 2021), 2.

telescope only functioned to collect the faint light of the new moon, then the development of camera technology and CCD (Charge Couple Device) as well as computer-based image processing has made it easier to observe.[14] So the contrast of the new moon can be slightly increased. Observations of the new moon using various technologies and digital cameras are now not only to determine the beginning of the Hijri month, but also become a record-breaking event for the closest elongation distance, as has been done by Thiery Legault.[15]

Astronomy can be said to be Islamic Astronomy, and modern astronomy is characterized by three main characteristics, namely[16] advances in observation and high-accuracy devices (telescopes with various detector systems, both from the earth's surface and from space), advances in computing technology (modeling and programming) and advances in information technology (multimedia technology and the internet for dissemination of results). The question is, is the telescope able to answer the difficulties that occur in the field? Schaefer (1991) research results[17], Based on the results of observing the new moon in various places with the naked eye and using a telescope and the theoretical model he developed, it is concluded that even with a telescope it is still impossible to observe the new moon if the angular distance of the sun-moon is less than 7 degrees. Because the main problem in observing the new moon is the contrast between the new moon and the light of the evening sky.

So, digitization doesn't make all of that feel right, and it's always been. It's just that a technology serves to facilitate the performance of human work so that it can be done faster and does not take quite a lot of time. However, it does not mean that the existence of modern tools makes people lazy to study astronomy itself. As described above, for example, determining the Qibla direction using the application is not always accurate due to data that may be incorrect when entered into the application, or data that turns out to be different from the data that should be used. Applications should only be used individually, not in the interests of the wider community such as the construction of mosques. If you want to apply

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[14] Ikhwan Yanuar, "Mengenal Alat Tradisional dan Modern Pemantau Hilal," Viva.co.id, May 2017.

[15] Adi Damanhuri, "Sistem Pengamatan Hilal ISRN UHAMKA," *Al-Marshad: Jurnal Astronomi Islam dan Ilmu-Ilmu Berkaitan* 4, no. 1 (June 2018): 2–3, https://doi.org/10.30596/JAM.V4I1.1931.

[16] Thomas Djamaluddin, "Hisab Rukyat dalam Astronomi Modern," n.d.

[17] Djamaluddin.

Astrology in determining the Qibla direction in a mosque, the measurement used is the Theodolite, a tool which for now according to astronomers is said to be accurate. This also applies to applications that are used to determine the start of prayer times and others.

Regarding digitization in the *rukyatul hilal* process, it is also difficult to observe the *hilal* which has a very thin physical form, and is difficult to see with the naked eye, so that digitalization innovation is very helpful for observers in observing the *hilal*. However, before technology is used, an in-depth study of sharia is needed, because technology must not ignore sharia.

C.4 Digitalization of Astronomy in Indonesia

The digitalization of astronomy in Indonesia is experiencing rapid development. This can be seen from the many emerging applications based on android and web. These applications were created by Indonesian astronomy scientists who have a concentration in the field of astronomy development. The digitization of astronomy in Indonesia is growing quite rapidly, some of which we can download through the Google Play Store platform for free and free of charge. Among these applications are Auqot, Hisab Abajadun, Rubuk Mujayyab celestial, Astrological Simulation and Ephemeris Meus produced by Kadzalik Lab and Al Faizin, Digital astronomy by Ahmad Tolhah Ma'ruf, Mizwandroid, a collaboration between Waluku Studio and the creator of the Mizwala astronomy tool. namely Hendro Setianto, and Islamicastro by Muhammad Faisol Amin.

a. Kadzalik Laboratory

Kadzalik Laboratory is an association forum created for the development of knowledge at the Darusa'adah Islamic Boarding School 3 Celikah Seputih Jaya Gunung Sugih, Central Lampung, Lampung. One of the concerns in the development is the study of astronomy. So, it takes a touch of modernization in it so that it becomes interesting to learn, one of which is implementing it into the digital world. Some digital applications created by Kadzalik Lab include: firstly, *Auqot*[18]with a height value of -18 isya and dawn -20. In addition, there are 8 other astronomical reckoning tools that can

[18] Kadzalik Lababoratory, "Auqot," Google Play Store, n.d., https://play.google.com/store/apps/details?id=com.kadzalik.auqot&hl=in&gl=US.

be used such as Day Market, Age Range, Digital Tasbih, Hijri-Christian Conversion and vice versa, Counting Deaths, *Fidyah Qodlo'* prayer and 24-hour Ephemeris Data, Meeus Algorithm. Secondly, *Hisab Abajadun*[19]is an application to calculate the value of a name, where the application will automatically display the alphabetical value of the name entered into it according to the famous alphabet table. In addition, there are also "fits in harmony" and the character of a person which we adapted from the book of Abu ma'syar alfalaky. Third, *Rubuk Mujayyab Falak*[20] is a measuring tool / calculating various things, one of which is prayer times and Qibla direction. It is now available in digital form and has also been equipped with Mark/Muri like the original tool.

b. Mizwandroid Instrument

Mizwandroid[21] is a collaboration product between Waluku Studio and *Mizwala* Falak Instruments as a tool to calculate and find the Qibla direction. This app uses a compass to determine the direction of the device. Calibrating the true north of the compass using the position of the sun or moon will get more accurate data. This application is a form of collaboration between Waluku Studio and the creator of the *Mizwala* astronomy tool, Hendro Setianto, in order to facilitate and introduce *Mizwala* more broadly to the wider community. Mizwandroid is a very good form of digitizing astronomy science in Indonesia, because the tool was created by Indonesians and then digitized by Indonesian children.

c. Islamicastro

Islamicastro[22] is an astronomy application that contains several features including: Istiwa' Mobile, Qibla Compass, Sun and Moon Ephemeris, Sun and Moon Positions and Prayer Times. This application was created by Muhammad Faishol Amin, one of the lecturers of the Sharia Faculty at the Qomaruddin Gresik Islamic Institute. This

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[19] Kadzalik Lababoratory, "Abajadun," Google Play Store, n.d., https://play.google.com/store/apps/details?id=com.kadzalik.abajadun&hl=in&gl=US.

[20] Kadzalik Lababoratory, "Rubu' Mujayyab Falak," Google Play Store, n.d., https://play.google.com/store/apps/details?id=com.kadzalik.rubuk&hl=in&gl=US.

[21] Waluku Studio and Mizwala Falak Instruments, "Mizwandroid," Google Play Store, n.d., https://play.google.com/store/apps/details?id=com.walukustudio.mizwandroid&hl=in&gl=US.

[22] Muhammad Faishol Amin, "Islamicastro," Google Play Store, n.d., https://play.google.com/store/apps/details?id=com.gresikdev.islamicastro&hl=in&gl=US.

application is expected to help and facilitate the activists and students of astronomy in practicing astronomy.

D. Conclusion

Digitalization is a new era in the development of science, where currently all educational needs are in one hand. The effects of digitalization in science also finally make a real contribution in the form of ease of access and information. This effect is also felt in astronomy science, where the digitization of astronomy provides high flexibility and ease of access and information in the development of astronomy studies, especially in Indonesia. The emergence of various kinds of web and android-based applications, shows that the contribution of digitization in the development of astronomy has gone in a better and contemporary direction. So that the development of technology in this digitalization era, the development of astronomy is also growing rapidly and is starting to be in great demand by the general public.

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